Draft
Removal Action Report

for

TMK (3) 2-2-30: 17&19
Hilo, Hawaii

Prepared by:
Nimbus Environmental Services

28 November 2017

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0.0 EXECUTIVE SUMMARY

Parcels TMK (3) 2-2-30: 17&19 in Hilo, Hawaii (Property) are the last remnants from several sub-divisions of a larger holding that was the site of a *canec* production facility from the 1930s until 1963. *Canec*, a wall- and ceiling-board panel manufactured from sugar cane bagasse was used extensively as a building material in Hawaii until the 1970s. When manufacturing *canec*, the bagasse was treated with inorganic arsenic to provide resistance to pest infestations, primarily termites. *Canec* manufacturing resulted in residual arsenic contamination in soils of the subject parcels.

Hawaii Department of Health (HDOH) criteria for bio-accessible arsenic concentration indicate that parcels TMK (3) 2-2-30: 17&19 contain Category B, C, and D soils. Field investigations for these parcels show that "soil" is the over-burden layer of approximately 12-15 inches thickness that overlies a highly fractured native lava substrate. Category B soil (minimally impacted, un-restricted land use) dominates these parcels, with a volume of approximately 6050 cubic yards. Category C soil (moderately impacted, commercial/industrial land use only) is present in lesser quantity of approximately 2625 cubic yards. Category D soil (heavily impacted, removal/remedial action required) is present in the least amount with a volume of approximately 2155 cubic yards. Category D soil is restricted to approximately 20% of the total parcels land area. Management of Category C & D soils is the subject of this Draft Removal Action Report.

Four (4) Removal Action Alternatives were developed and evaluated for management of C & D soils on the Property.

<u>*Alternative 1 - No Action*</u>, did not meet removal action objectives, did not meet evaluation criteria for effectiveness, and will not meet regulatory requirements. This alternative was discounted and did not receive further analysis.

<u>*Alternative 2 - Excavation and Off-site Disposal of D Soil, On-site Containment of C Soils, Full-scale Fill/Grading Site Development in Near-term*</u>, fully met all removal action objectives, will fully meet regulatory requirements, and fully met evaluation criteria for feasibility and effectiveness. This alternative did not fully meet the evaluation criteria for cost. To implement this alternative, full-scale fill and grading site development in the near-term is required. The containment cells proposed for C soils are integral with landscaping features and finished grade construction across the entire parcels area. Therefore, to construct the landscaping features (containment cells) will require full-scale fill and grading site development. The near-term investment for this level of site development is not

economically feasible for the current owner or the prospective purchaser. Based on economic considerations, phased development is the most probable course of action for the Property. For reasons of prohibitive costs, this alternative was not selected as the preferred alternative.

Alternative 3 - Excavation and On-site Containment of C & D Soil, Full-scale Fill/Grading Site Development in Near-term, did not result in sufficient confidence that removal action objectives will be fully met. Evaluation criteria for feasibility, effectiveness and cost were not fully met. It remains indeterminable whether regulatory requirements can be met. Similar to Alternative 2, this alternative will require full-scale fill and grading site development in the near-term. The containment cells for C & D soils are integral with finished grade construction across the entire parcels area. Therefore, to construct the landscaping features (containment cells) will require full-scale fill and grading site development. However, there are significant uncertainties for constructability for the expanded containment cells to contain D soils, compared to Alternative 2 where only C soils are contained. For reasons of uncertainty in constructability, and prohibitive costs, this alternative was not selected as the preferred alternative.

Alternative 4 - Excavation and Off-site Disposal of D Soil, In situ Management of C Soils in Near-term, Phased Site Development (Future), fully met all removal action objectives, will fully meet regulatory requirements, and fully met evaluation criteria for feasibility, effectiveness, and cost. Under this alternative the D soils will be excavated and removed from the site for disposal at the RCRA-compliant West Hawaii Sanitary Landfill, an HDOH-approved disposal facility. Category C soils will remain on-site *in situ*, under vegetation cover (DU2) and under soil cover (DU7 Deep) with institutional controls to help prevent exposure or disturbance until phased commercial development is planned and implemented at future dates. Management of C soils *in situ* is a viable option because arsenic in Hawaii volcanic soils does not leach appreciably and does not bio-accumulate to a significant extent in terrestrial plants found at this site. Also, the presence of Category C soils is permissible for commercial and industrial development according to Hawaii DOH Tier 2 guidance. Future management of the C soils will be addressed with Hawaii DOH HEER Office as successive site development phases are planned and implemented at future dates.

The recommended Removal Action is Alternative 4.

Estimated cost for Alternative 4 = $312,825.

A Removal Action Environmental Hazards Management Plan (Removal EHMP) is required by HDOH for activities associated with removal of D soils. This EHMP will be prepared in accordance with HDOH guidance and must receive HDOH approval. This EHMP is not required at this time for Draft RAR review, but will be required by HDOH before removal of D soil proceeds.

Major components of the Removal EHMP are control of fugitive dust and erosion during the removal action, and worker protection, due to the potential for arsenic exposure or movement of arsenic off-site.

A Site Environmental Hazards Management Plan (Site EHMP) is required by HDOH for interim management of C soils that will remain on site until phased development proceeds at a future date. This EHMP will be prepared in accordance with HDOH guidance and must receive HDOH approval. This EHMP is not required at this time for Draft RAR review, but will be required by HDOH after D soil removal.

Major components of the Site EHMP are institutional controls that will prevent disturbance of C soils until future development plans are approved by HDOH in accordance with regulations for C soils management.

Removal of Category D soils from the Property and the maintenance of undisturbed *in situ* C soils will result in a *No Further Action with Institutional Controls* letter from the Hawaii DOH HEER Office. This letter will indicate that no further action is required with regard to the Category D soil and that planning and development may proceed in accordance with regulations regarding the long-term on-site management of remaining Category C soils.

The selected removal action, *Alternative 4*, provides a cost-effective course of action to remove arsenic-contaminated D soils on parcels TMK (3) 2-2-30: 17&19. Implementation in accordance with the required Removal EHMP will provide for safe removal of Category D soils from the site, and will set conditions for future commercial development of these parcels. Removal of D soils will eliminate the present-day unmanaged risk of arsenic exposure in human and ecological receptors. Future site development will provide opportunities for socio-economic benefits to the Hilo community.

1.0 INTRODUCTION AND PURPOSE

1.1 Introduction

Parcels TMK (3) 2-2-30: 17&19 in Hilo, Hawaii are the last remnants from several sub-divisions of a larger holding that was the site of a *canec* production facility from the 1930s until 1963 (herein "Property" or "site"). *Canec*, a wall- and ceiling-board panel manufactured from sugar cane bagasse was used extensively as a building material in Hawaii until the 1970s. Bagasse is the fibrous plant residue that remains after the juice is extracted from the sugarcane plant. When manufacturing *canec*, the bagasse was treated with inorganic arsenic to provide resistance to pest infestations, primarily termites. *Canec* manufacturing resulted in residual arsenic contamination in soils of the subject parcels.

Arsenic contamination in soils of Parcels 17&19 was characterized in a *Phase I Environmental Site Assessment Update* submitted to Hawaii Department of Health (HDOH) in February 2017. The *Phase I ESA Update* was prepared by Nimbus Environmental Services (*NES*) in accordance with ASTM E1527-13 standards and guidance from HDOH Hazards Evaluation and Emergency Response Office (HEER Office). In April 2017, the *Phase I ESA Update* received HEER Office approval as the basis to address soil arsenic contamination on Parcels 17&19.

The *Phase I ESA Update* revealed that the sole Recognized Environmental Condition (REC) in connection with the Property is arsenic contamination in soils. The range of contamination, according to HEER Office Technical Guidance Manual Appendix 9-E, is from minimally impacted soils (Category B) for the majority of the parcels, to two areas of moderately impacted soils (Category C) and one area of heavily impacted soil (Category D).

To support commercial development on Parcels 17&19, preparation of this Removal Action Report (RAR) is required, to include a summary Environmental Hazard Evaluation (EHE) and a Removal Alternatives Analysis (RAA).

The Property consists of ~ 6¼ acres of vacant land, vegetated, flat to moderately sloping, situated among commercial and residential development south of the Wailoa State Park and ~ 500 ft from Waiakea Pond in downtown Hilo.

1.2 Purpose of Removal Action Report (RAR)

The purpose of this RAR is to present soil management alternatives to address elevated soil arsenic at Parcels TMK (3) 2-2-30: 17&19. Each alternative is described in detail and evaluated in terms of *effectiveness*, *feasibility* and *cost*. A recommendation is presented for the preferred alternative. The preferred alternative achieves arsenic management objectives, sets conditions for the potential future phased construction of commercial/retail space, and minimizes identified potential hazards to human health and the environment.

This RAR was commissioned by a prospective purchaser that is considering future commercial development on the Property.

2.0 BACKGROUND

2.1 Site Description

The Property consists of 2 adjacent parcels located in the northwest quadrant of the intersection of Kekuanaoa and Mililani streets in downtown Hilo on the east coast of the Island of Hawaii (Table 2.1a). Hawaii County assessor maps are provided in Appendix A. Property photographs are provided in Appendix B.

Table 2.1a. Property Characteristics

Address:	Northwest quadrant, intersection of Kekuanaoa and Mililani Streets, Hilo, Hawaii
Tax Map Key:	(3) 2-2-30: 17&19
Total Land Area:	6.23 acres
Surface Improvements:	Unused tennis court and check-in stand (wood frame, ~ 1000 ft^2) on Parcel 19
Sub-surface Improvements:	None
Current Use:	Unoccupied, undeveloped, vegetated
Zoning:	Commercial, Hotel (CG-7.5) / Hotel & Resort (V-.75)
Current Owner:	David S. De Luz, Sr. Revocable Trust

Elevation across Parcels 17&19 is generally consistent at ~15 +/- ft above mean sea level. Topographical relief for Parcels 17&19 is ~ 5 ft (differential from lowest to highest elevation points), except for the raised western portion of Parcel 17 which is ~ 5 ft higher than the overall topographic profile.

Regionally, the surrounding area slopes gently downward toward the north east, from the mountains to the ocean.

Topography of Parcel 17 (southern parcel) is dominated by a central shallow basin. The adjacent land, i.e., Parcel 19 (north), Mililani St. (east), Kekuanaoa St. (south), and the Hawaii Federal Credit Union property (west) are all slightly elevated in comparison to the central basin of Parcel 17.

Topography of Parcel 19 (northern parcel) is flat and generally level with the Waiakea Villas parking area (west), Hualani St. (north) and Mililani St. (east).

Parcels 17&19 are within Flood Hazard Zone "X" (Federal Emergency Management Agency [FEMA] Panel 1551660880C, 09/16/1988), and are determined to be outside the 100-year and 500-year flood plain. The Property is within the NOAA tsunami ("*tidal wave*") evacuation zone (NOAA Pacific Tsunami Warning Center website 08/30/2016).

2.1.1 Climate

The Property vicinity has a wet, tropical climate. There is minimal seasonal variance in temperature, and a high typical relative humidity of ~80%. The average rainfall in Hilo in the vicinity of the Property and the Hilo International Airport is ~150 inches annually.

2.1.2 Soils / Geology

The Island of Hawaii is of geologically recent volcanic origin. The Property is located on the lower slopes of the active Mauna Loa volcano. Mink & Lau (1993) described the geology of the area as covered with pre-historic lava of the Kau Basalt onto which long tongues of historic lavas from the northeast rift have flowed, and with no sediments other than scanty recent alluvium.

Review of the 2013 US Geological Survey *7.5-minute* topographic map indicates:

(1) the Property is situated in the high-density urban region of Hilo at an elevation of ~15-20 ft above mean sea level (consistent with the surrounding terrain);

(2) regionally the land is topographically sloped downward to the northeast;

(3) localized drainage is towards the center of the Property, and;

(4) the nearest body of water is the Waiakea Pond located ~500 ft to the northwest of Parcel 19; Waiakea Pond is tidal and flows into the Wailoa River which subsequently drains into Hilo Bay.

The soils of Parcels 17&19 are classified as Type 640 – Opihikao-Urban Land Complex, 2 - 20 percent slopes (national map unit symbol 2kII8). Soil designation was obtained from the USDA Natural Resources Conservation Service Web Soil Survey 08/04/2016 (Appendix C). Soil Type 640 is 45% Opihakao and similar soils (organic material over pahoehoe lava flows), 45% Urban land (lava flows), and 10% minor components. Soil properties and qualities include 2 – 10 inches to lithic bedrock, well drained, runoff class high, capacity to the most limiting layer to transmit water low to moderate (0.00 to 0.06 in/hr), depth to water table greater than 80 inches, frequency of ponding or flooding none, and available water storage in profile very low (~ 0.7 inches). Soils of Parcels 17&19 are in hydrologic soil class Group D (soils having a very slow infiltration rate, *i.e.*, high runoff potential when thoroughly wet) and have a very slow rate of water transmission.

The slow infiltration and transmission rates when wet are indicative of highly organic soils. Although infiltration rates for the Property are low, runoff potential is minimal because soil thickness is generally 3-15 inches (Appendix D) and soil is underlain by an open system of highly fissured native lava. The shallow basin that dominates Parcel 17 retains water on the surface via small-scale localized intermittent ponding which is evident after moderate to heavy rainfall.

2.1.3 Surface Water

The Property is located ~ 4000 ft south of Hilo Bay. Waiakea Pond is located ~500 ft northwest of Parcel 19 (nearest point of Property proximity to pond). There are no surface waters on the Property (e.g., ponds, lakes, streams, rivers or estuaries).

2.1.4 Groundwater

The Property is underlain by the Hilo Aquifer System, which is part of the Northeast Mauna Loa Sector on the Island of Hawaii. The aquifer is classified by Mink & Lau (1993) with system identification number 80401111 (11111). This system includes an unconfined basal aquifer in flank lavas (horizontal extensive). The groundwater in this aquifer is fresh with less than 250 mg/L Cl^- and is currently used as a drinking water source up-gradient from the Hawaii DOH UIC-line. It is also described as irreplaceable with a high vulnerability to contamination (Mink & Lau 1993). However, the groundwater of the Property is not a drinking water source (see discussion on UIC-line below).

Groundwater movement beneath the property is from the west-southwest to the east-northeast, with a volume flow rate on the scale of millions of gallons per day (Takasaki 1993). The horizontal extent of the continuous aquifer beneath the Property in this vicinity of Hilo is at the scale of square miles. The Property occupies only a very small fraction (6+ acres) of the overlying land surface that contributes infiltration to this expansive open aquifer system.

The Hawaii DOH has established an Underground Injection Control line ("UIC-line") as a boundary between underground sources of drinking water and exempted (non-drinking water) portions of aquifers. Under Hawaii DOH Administrative Rules Title 11 Chapter 23, areas landward of the UIC-line are defined as drinking water portions, and areas coastward of the UIC-line are defined as exempted portions of aquifers. Parcels TMK (3) 2-2-30: 17&19 lie over an exempted portion of the aquifer, coastward of the UIC-line. The UIC-line is located approximately along Kilauea Avenue in Hilo (Appendix E).

2.1.5 Historical Land Use

Historical information concerning the Property was gathered from public land records, State of Hawaii archived information, contacted information sources, historical aerial photography, US Geological Survey topographic maps, local street directories, and Certified Sanborn Maps. Selected historical records are provided in Appendix F.

Historical records show that TMK (3) 2-2-30: 03 originally included the Property (Parcels 17&19) as well as parcels 15, 16 and 18 which are now part of the Waiakea Villas development. In the late 1880s this area of Hilo, including TMK (3) 2-2-30: 03, was occupied by sugar cane fields of the Waiakea Mill Company. The plantation was enlarged to approximately 350 acres of sugarcane by 1920 and a company sugar mill was located ~ 1½ miles southwest of the present-day Property.

In 1932, Hawaiian Cane Products Limited developed a manufacturing plant to produce *canec* wallboard panels on TMK (3) 2-2-30: 03 (bordered by Waiakea Pond, Kekuanaoa St. and Mililani St.). *Canec* was manufactured at this site from 1932-1963. *Canec* was used extensively as a building material in Hawaii until the early 1970s. During manufacturing the fiber-board was treated with inorganic arsenic to prevent damage from mildew and insect infestations, primarily termites.

The *canec* manufacturing plant was located largely on the current Waiakea Villas site (see Appendix F and cover photo). A power/steam generation station and bulk fuel storage facility were located immediately adjacent to Waiakea Pond, approximately 800+ ft from present-day Parcels 17&19. Bagasse storage was located in the area of the present-day Hawaii Federal Credit Union west of Parcel 17. A wrapping and shipping building and two storage buildings were located on the western portion of present-day Parcel 17. A small storage building was located on present-day Parcel 19. During this time in Property history it appears that the southeast half of Parcel 17 was an open area where goods were received and finished product were shipped.

Hawaiian Cane Products Limited sold the manufacturing facility to the Flintkote Company in 1948 and c*anec* operations continued until 1963. Market factors for *canec*, the 1960 tsunami, and a fire *c*. 1961-62, all influenced the Flintkote Company decision to close the facility in 1963 (State of Hawaii 1963).

The C. Brewer Company purchased TMK (3) 2-2-30: 03 in 1965 and demolished the *canec* plant in 1966. In 1971 Brewer subdivided TMK (3) 2-2-30: 15 from the original parcel 03 and sold the remaining portion, including the Property (present-day parcels 17&19). The remaining portion of the property was sold several times and re-divided. Present-day Parcel 17 of the original parcel 03 has remained vacant and undeveloped since 1966. Present-day Parcel 19 was minimally developed and used until the 1980s, as discussed below.

2.1.6 Current use of Parcels 17&19

Parcel 17 (southern parcel) is an undeveloped irregular-shaped parcel of approximately 4.4 acres. This parcel has road frontage on Kekuanaoa St. (south), and Mililani St. (east) and borders the access road/parking lot for the Hawaii USA Federal Credit Union (west). Parcel 17 currently consists of moderately sloping vacant land covered with vegetation. Grasses, vines, shrubs, and canopy trees were cut/chipped on-site in July 2017. A remnant concrete and stone foundation from the Waiakea Villas development is located on the extreme western edge of Parcel 17. Otherwise, no infrastructure is known to occur on this parcel.

Parcel 19 (northern parcel) is a rectangular-shaped flat parcel of approximately 1.8 acres. This parcel has road frontage on Mililani St. (east), Hualani St. (north), and is bordered by Parcel 17 (south) and Waiakea Villas (west). There is an unused two-court tennis court surrounded by a dilapidated chain-link fence, and a small (~1000 ft^2) unused dilapidated wood frame building, reportedly a check-in stand formerly used by the Waiakea Racket Club. An asphalt walkway connects the parking lot of the Waiakea Villas (west) to the tennis courts. It appears from the TMK record that the tennis courts and structures were constructed *c*. 1976. Use of the tennis courts was discontinued in the 1980s. There has been no further development on Parcel 19 since 1976. Approximately half the area of Parcel 19 is managed for landscaping by the Waiakea Villas development. Vegetation on Parcel 19 consists mainly of landscaping (grasses, boulders, trees) with untended tree and shrub growth on the southern margin (south of tennis courts) where Parcel 19 adjoins Parcel 17.

2.1.7 Current Use of Properties Adjoining Parcels 17&19

Land use for properties adjoining and nearby to Parcels 17&19 is described in Tables 2.1b & 2.1c below.

Table 2.1b. Current Property Use Adjacent to Parcel 17

East	Mililani St.; primarily single-family residential dwellings with one residence converted to a Labor Union Hall (Local 368)
West	Hawaii USA Federal Credit Union
North	Waiakea Villas; condominium/apartment complex with access roads, pond, pool, and several commercial establishments
	Parcel 19 (unused tennis court development)
South	Kekuanaoa St.; mix of residential and commercial buildings including BEI Hawaii (agriculture supply store), Big Island Used Cars, plus various other small commercial buildings set back from the road

Table 2.1c. Current Property Use Adjacent to Parcel 19

East	Mililani St.; primarily single-family residential dwellings with one residence converted to a Labor Union Hall (Local 368)
West	Waiakea Villas; condominium/apartment complex with access roads, pond, pool, and several commercial establishments
North	Hualani St.;. access road for Waiakea Villas; north of Hualani St. is an undeveloped parcel that borders Waiakea Pond
South	Parcel 17 (undeveloped, vegetated)

2.1.8 Future Use of Parcels 17&19

The Property is subject to current zoning unless a change of zoning is requested and subsequently approved. Zoning is Commercial (CG-7.5) / Hotel & Resort (V-.75) and will support general commercial/retail development. It is not possible to determine all possibilities of future development on these parcels. It is most likely that future land use will be in accordance with prevailing zoning if the Property is developed.

2.2 Environmental Site Investigations / Reports for Parcels 17&19

Presently there are 10 environmental documents (known to *NES*) that report on various environmental aspects for all or parts of the Property. Environmental investigations for these parcels span 28 years (1989-2017) during which there have been numerous changes in Hawaii statutes and regulations. Reports and content relevant to present-day Parcels 17&19 are summarized below.

(1) Woodward-Clyde Consultants (WCC) 1989: *Report for Waiakea Village, Hilo, Hawaii*

Property: Original parcel TMK (3) 2-2-30: 03

Summary: Eleven (11) surface grab samples and 18 bore holes (37 total samples at 0-3 ft bgs) were collected and analyzed for total arsenic. One of the surface soil samples (SG-3) and 5 of the 18 bore holes (B-1, B-3, B-14, B-16, and B-17) were apparently collected on Parcel 17&19. Nine (9) of the 11 soil samples from the 5 soil borings on Parcel 17&19 showed total arsenic concentrations greater than the US EPA non-carcinogenic Preliminary Remediation Goal (PRG) for direct contact exposure pathway in residential soils (22 mg/kg). The arsenic concentrations did not display a direct correlation with respect to depth. Six (6) samples from the Property that had concentrations > 100 mg/Kg (concentration that could potentially be defined as hazardous waste if sample failed the EP Toxicity test) were tested for extractable arsenic using EP Toxicity methods. Based on the test results WCC concluded that all soils did not meet criteria for a hazardous waste, and had a very low potential for mobilization. However, WCC recommended a qualitative health risk assessment be performed based on arsenic concentrations in the soil.

NES Note:
The US EPA PRGs are presented by way of summarizing the WCC work; current HDOH EALs supersede the US EPA PRGs.

(2) Woodward-Clyde Consultants (WCC) 1989: *Qualitative Risk Assessment for Arsenic at the Waiakea Village in Hilo, Hawaii*

Property: Original parcel TMK (3) 2-2-30: 03

Summary: WCC reiterated that the soils do not meet criteria for a hazardous waste and concluded that no cleanup of soils was required. Exposure pathways for arsenic contaminated soil that could potentially result in human health risk are limited to direct ingestion of soil or inhalation of soil dust. This exposure was considered low risk because most of site is covered by vegetation and man-made structures and pavements.

Potential exposure for short-term visitors and permanent on-site staff was not expected to be significant. Fugitive dust from arsenic contaminated soils may be considered as a direct ingestion risk, but the potential for fugitive dust from the Waiakea Village development was not expected to be significant because of land cover.

(3) J. R. Herold & Associates (JRHA) 1999: *Phase I ESA, Waiakea Lot 6, Hilo, Hawaii*

Property: TMK (3) 2-2-30: 17

Summary: No sampling was conducted as part of this work. JRHA concluded that the property is part of a Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) listed site as regards the former *canec* plant but is otherwise not on any regulatory agency list. Notwithstanding the CERCLIS listing, JRHA concluded that the Property poses no immediate environmental or human health risk, based on an opinion expressed by the Hawaii Department of Health.

(4) Hawaii International Environmental Services, Inc. (HIES) 2001: *Letter Report – Expert Review of the Report Titled: Phase I ESA Report, Waiakea Lot 6, Hilo Hawaii by JHRA 05/10/1999*

Property: TMK (3) 2-2-30: 17

Summary: No sampling was conducted as part of this work. HIES recommended that a new Phase I ESA and a Phase II ESA should be conducted for the property.

(5) Hawaii International Environmental Services, Inc. (HIES) 2001: *Letter Report - Phase II ESA Report, Waiakea Lot 6, Hilo Hawaii and Arsenic Investigation*

Property: TMK (3) 2-2-30: 17

Summary: Discrete soil surface grab samples (total of 19) were collected and tested for total arsenic (18 on the property, 1 background sample) based on a biased grid methodology. For 15 of the 18 surface soil samples, the total arsenic concentrations were greater than the US EPA non-carcinogenic Preliminary Remediation Goal (PRG) for direct contact exposure pathway in residential soils (22 mg/kg). HIES concluded that elevated concentrations of arsenic are likely present on the property and neighboring properties. HIES further concluded that the property could be developed, provided that the arsenic-impacted soil was properly managed and that worker and public exposure risks were addressed.

HIES was of the opinion that there was a risk of possible third-party liability associated with the off-site arsenic impacts based on analytical results from the off-site “background” surface soil sample.

NES Note:
The US EPA PRGs are presented by way of summarizing the HIES work; current HDOH EALs supersede the US EPA PRGs.

(6) Walker Consultants Limited (WCL) 2004: *Phase I ESA Report* (included a Limited Phase II ESA)

Property: TMK (3) 2-2-30: 17

Summary: Twelve (12) discrete grab soil samples (1 surface and 1 ~1-2 ft below ground surface from each of 6 randomly selected sampling points) were collected and analyzed for total arsenic. Arsenic levels in 8 samples were greater than the US EPA non-carcinogenic Preliminary Remediation Goal (PRG) for direct contact exposure pathway in residential soils (22 mg/kg). The total arsenic concentrations displayed a direct correlation with respect to depth, with all concentrations higher in surface samples than at 1.5 ft below ground surface. The sample with the highest total arsenic concentration was also analyzed for the Toxicity Characteristic Leaching Potential (TCLP). The result was significantly lower than the federal maximum concentration of the toxicity characteristic of 0.5 mg/L. These findings are consistent with expectations that arsenic is strongly adsorbed on high iron-oxide content volcanic soils, and is therefore highly immobilized. WCL concluded that some of the total arsenic found in the soil samples contains arsenic from manmade sources, however the low Toxicity Characteristic Leaching Potential (TCLP) indicates the soil is non-hazardous for disposal purposes at an approved sanitary landfill.

NES Note:
The federal maximum TCLP concentration for arsenic is 5.0 mg/L, *not* 0.5 mg/L as reported by WCL.

NES Note:
The US EPA PRGs are presented by way of summarizing the WCL work; current HDOH EALs supersede the US EPA PRGs.

(7) Hawaii Environmental (HE) 2007: *Phase I ESA*

Property: TMK (3) 2-2-30: 17&19

Summary: No sampling was conducted as part of this work. HE concluded that the known elevated arsenic concentrations in the soil on the parcels are a Recognized Environmental Condition (REC).

(8) Environmental Resources Management (ERM) 2007: Proposed Phase II ESA (no report generated or submitted to Hawaii DOH HEER Office)

Property: TMK (3) 2-2-30: 17&19

Summary: ERM established 7 Decision Units (DUs), 5 on Parcel 17 and 2 on Parcel 19. In their proposal for the work ERM received agreement from Hawaii DOH that only surface soils (to depth of 3-6 inches) needed to be sampled on Parcel 17 because: (1) these are the soils that a future worker might be exposed to; (2) these soils are typically higher in arsenic content than deeper soils and therefore more conservative in a risk assessment (because arsenical compounds were applied to the surface), and; (3) previous analytical results from Parcel 17 support this rationale. Accordingly, ERM collected multi-increment (30-increment) surface soil samples on DUs 1-6 and multi-increment (30-increment) surface and subsurface (18-24 inches depth) soil on DU7 (Parcel 19). All samples were analyzed for total arsenic and bio-accessible arsenic.

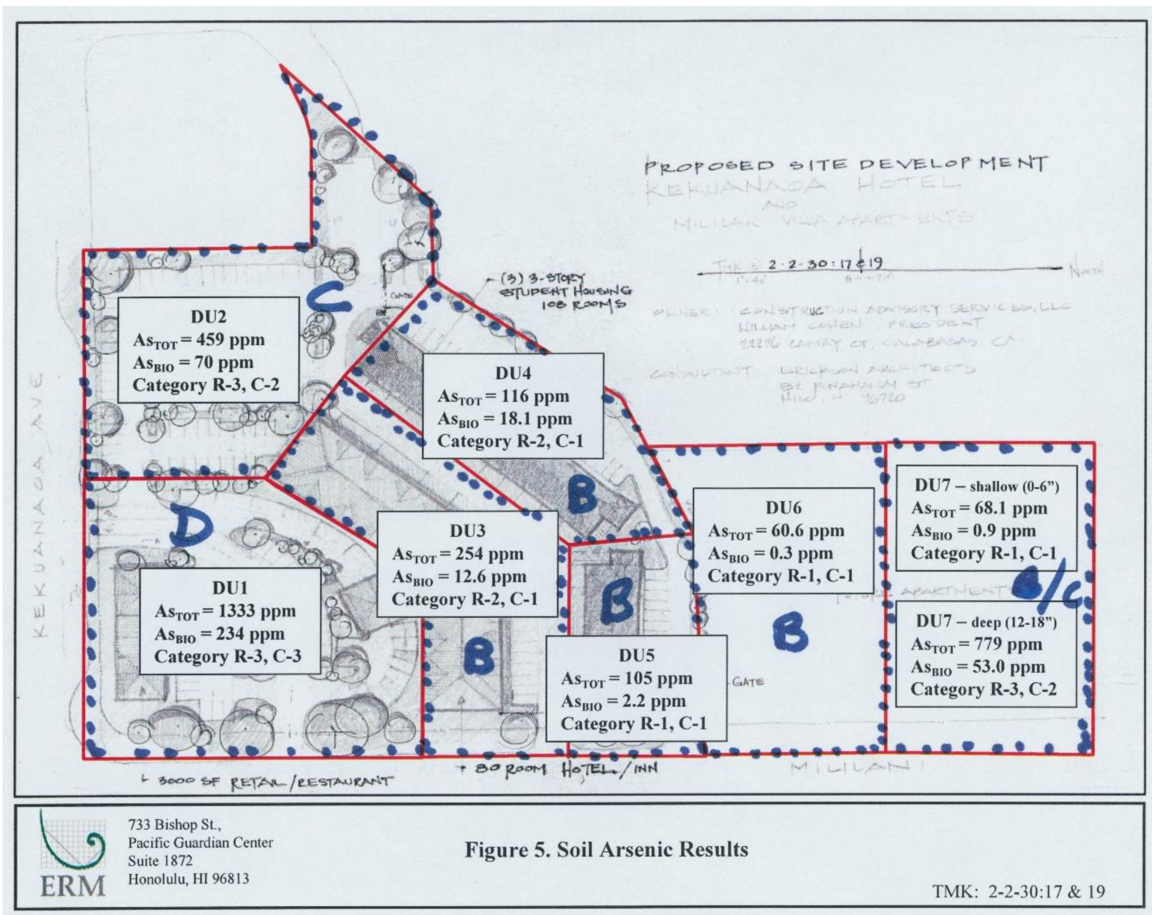
NES Note: The soils depth investigation report prepared by *NES* (Appendix D) indicates that soils on Parcel 17 are of depth 3-12 inches, with the majority of sample sites in the range of 3-9 inches. Only 1 sampling site on Parcel 17 had soil depth of 12 inches. Soil depth on Parcel 19 varied from 8-15 inches.

NES Note: The ERM work was the first study for the Property that collected multi-increment soil samples (as now required by Hawaii DOH) and also the first to analyze samples for bio-accessible arsenic. Bio-accessible arsenic is the fraction of total arsenic that might be toxic, which is the parameter by which Hawaii DOH assigns soil categories (A, B, C or D) to assess potential human health risk and evaluate mitigation. Analytical results from the ERM work was available in the Hawaii DOH HEER Office files but no report was submitted to Hawaii DOH.

NES Note: ERM data indicates that on Parcel 17, DU1 has Category D soils (heavily impacted – removal/remedial action required), DU2 has Category C soils (moderately impacted – commercial/industrial land use only), DUs 3, 4, and 5 have Category B soils (minimally impacted – unrestricted land use).

NES Note: ERM data indicates that on Parcel 19, DU6 has Category B soils (minimally impacted – unrestricted land use), DU7 Shallow has Category B soils (minimally impacted - unrestricted land use) and DU7 Deep has Category C soils (moderately impacted – commercial/industrial land use only). See ERM summary figure (Figure 1, annotated).

NES Note: For DU7, ERM data indicates an elevated arsenic concentration in the subsurface compared to surface. A likely explanation for this is the mixing of surface with subsurface soils during site preparation work for the tennis courts development, and the contribution of imported low-arsenic fill material at the surface.



Source: Hawaii DOH HEER Office file record

Figure 1. ERM Soils Category Summary – Annotated (*NES*)

At the request of Hawaii DOH, ERM analyzed 2 of the multi-increment surface soil samples plus a duplicate (DU2, DU2 duplicate, and DU3) for organochlorine pesticides by EPA method 8081A due to known pesticide impacts in nearby Waiakea Pond sediments. Pesticides levels were all non-detect (nd) except for two compounds.

Lindane was detected in the DU3 sample at 0.008 mg/kg, near the limits of analytical detection, and well below the Hawaii DOH Tier 1 Environmental Action Level of 0.037 mg/kg for Unrestricted Land Use, Nondrinking Water Resource, Distance to Surface Water <150 m.

Alpha Chlordane, which is a component of Technical Chlordane, was detected in the DU3 sample at 0.006 mg/kg, near the limits of analytical detection, and well below the Hawaii DOH Tier 1 Environmental Action Level of 17.0 mg/kg for Unrestricted Land Use, Nondrinking Water Resource, Distance to Surface Water <150 m. A facsimile of ERM analytical results is shown in Figure 2.

ERM (Environmental Resources Management) PROJECT #0067190
CAS Former Canec Site

ESN Project #D706050132

ORGANOCHLORINE PESTICIDES ANALYSES OF SOILS BY EPA 8081A MODIFIED

SAMPLE NUMBER	Method Blank	CAS DU2	CAS DU2 Dup	CAS DU3	PQL	MDL
DATE SAMPLED	-	5/31/2007	5/31/2007	5/31/2007		
DATE EXTRACTED	6/6/2007	6/6/2007	6/6/2007	6/6/2007		
DATE ANALYZED	6/6/2007	6/6/2007	6/6/2007	6/6/2007		
Alpha-BHC	nd	nd	nd	nd	0.005	0.002
Beta-BHC	nd	nd	nd	nd	0.005	0.005
Gamma-BHC (Lindane)	nd	nd	nd	0.008	0.005	0.002
Delta-BHC	nd	nd	nd	nd	0.005	0.004
Heptachlor	nd	nd	nd	nd	0.005	0.002
Aldrin	nd	nd	nd	nd	0.005	0.003
Heptachlor epoxide	nd	nd	nd	nd	0.005	0.003
Gamma-Chlordane	nd	nd	nd	nd	0.005	0.003
Endosulfan I	nd	nd	nd	nd	0.005	0.004
Alpha-Chlordane	nd	nd	nd	0.006	0.005	0.003
Dieldrin	nd	nd	nd	nd	0.010	0.003
p,p'-DDE	nd	nd	nd	nd	0.010	0.005
Endrin	nd	nd	nd	nd	0.010	0.003
Endosulfan II	nd	nd	nd	nd	0.010	0.005
p,p'-DDD	nd	nd	nd	nd	0.010	0.003
Endrin aldehyde	nd	nd	nd	nd	0.010	0.005
Endosulfan sulfate	nd	nd	nd	nd	0.010	0.005
p,p'-DDT	nd	nd	nd	nd	0.010	0.005
Endrin ketone	nd	nd	nd	nd	0.010	0.005
Methoxychlor	nd	nd	nd	nd	0.010	0.009
Chlordane (technical)	nd	nd	nd	nd	0.050	0.005
Toxaphene	nd	nd	nd	nd	0.25	0.10
	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
FLAGS						
SURROGATE RECOVERY (%)	125%	129%	125%	134%		

ACCEPTABLE RECOVERY LIMITS FOR SURROGATE (TCMX): 65%- 135%

QA/QC DATA - LABORATORY CONTROL SPIKE ANALYSES

	Laboratory Control Spike			Laboratory Control Spike Duplicate				
	Spiked Conc. (mg/kg)	Measured Conc. (mg/kg)	Spike Recovery (%)	Spiked Conc. (mg/kg)	Measured Conc. (mg/kg)	Spike Recovery (%)	RPD (%)	FLAGS
Beta-BHC	0.050	0.053	105.0%	0.050	0.048	96.6%	8.3%	
p,p'-DDE	0.100	0.104	104.1%	0.100	0.099	98.9%	5.1%	
Endrin aldehyde	0.100	0.103	103.4%	0.100	0.099	99.3%	4.0%	

QA/QC DATA - MATRIX SPIKE ANALYSES
Sample Name:
*Any hits in sample spiked for MS/MSD are subtracted before reported as measured concentration

	Matrix Spike			Matrix Spike Duplicate				
	Spiked Conc. (mg/kg)	Measured Conc. (mg/kg)	Spike Recovery (%)	Spiked Conc. (mg/kg)	Measured Conc. (mg/kg)	Spike Recovery (%)	RPD (%)	FLAGS
Beta-BHC	0.050	0.045	89.0%	0.050	0.045	89.6%	0.7%	
p,p'-DDE	0.100	0.093	92.8%	0.100	0.088	88.0%	5.3%	
Endrin aldehyde	0.100	Matrix Interference		0.100	Matrix Interference			

% Recovery LIMITS. 85% TO 115%
RPD LIMIT: 20%

ANALYSES PERFORMED BY : B. Capps
DATA REVIEWED BY: K. Carvallo

Source: Hawaii DOH HEER Office file record

Figure 2. ERM Pesticides Analytical Results

It is reasonable to conclude minimal use of organochlorine pesticides during the *canec* plant operations for control of termites to protect structures. Concrete and steel were predominant materials of construction for buildings on the Property as indicated on the historical Certified Sanborn Maps (Appendix F). The analytical results shown in Figure 2 are consistent with the assumption that minimal organochlorine pesticides were used on the Property during the *canec* era.

(9) EnviroServices & Training Center, LLC (ETC) 2011: *Limited Phase II ESA*

Property: TMK (3) 2-2-30: 17&19

Summary: ETC established 2 DUs, one each for Parcel 17 and Parcel 19. ETC collected triplicate multi-increment 50-increment surface soil samples for the Parcel 17 DU, and collected 1 multi-increment (50-increment) surface soil sample on Parcel 19 DU, using a stratified, random sampling protocol. Sampling depth was "0 to 4-6 inches" for Parcel 17 and Parcel 19, as indicated in the ETC report. Soil samples were analyzed for total arsenic only. Bio-accessible arsenic levels were estimated using an assumed 25% bioavailability factor. ETC concluded that for the Parcel 17 DU, all three multi-increment samples indicated Category C soils (moderately impacted – commercial/industrial land use only). For the Parcel 19 DU, soils were determined to be Category A (within range of expected background conditions).

(10) Nimbus Environmental Services (NES) 2017: *Phase I Environmental Site Assessment Update*

Property: TMK (3) 2-2-30: 17&19

Summary: The *NES Phase I ESA Update* was prepared in accordance with industry standard ASTM E1527-13 and included information from the 9 previous environmental investigation documents prepared for Parcels 17&19 from 1989-2011. The *Phase I ESA Update* revealed that the sole Recognized Environmental Condition (REC) in connection with the Property is arsenic contamination in soils. The range of contamination, according to the Hawaii Department of Health Hazards Evaluation and Emergency Response Office (HEER Office) Technical Guidance Manual Appendix 9-E, is from minimally impacted (Category B soils) to one area of heavily impacted (Category D soils). This *Phase I ESA Update* did not reveal the presence of Controlled RECs or Historical RECs relevant to the Property.

The *Phase I ESA Update* revealed that environmental investigation work is completed for the Property, and that no further soil sampling is required to characterize horizontal or vertical extent of arsenic contamination in Property soils, provided that a proposed site development scenario does not substantially deviate from the evaluation presented in the *Phase I ESA Update*. Hawaii DOH HEER Office provided written concurrence with this conclusion, which is presented in the *Phase I ESA Update*.

3.0 ENVIRONMENTAL HAZARD EVALUATION

As presented in the *Phase I ESA Update (NES* 2017*)*, the sole Recognized Environmental Condition (REC) in connection with the Property is arsenic contamination in soils. No Controlled RECs or Historical RECs were determined for TMK (3) 2-2-30: 17&19. This Environmental Hazard Evaluation (EHE) evaluates potential human health and environmental hazards for future site construction and site use due to the presence of arsenic-impacted soils.

3.1 Applicable Arsenic Screening Environmental Action Levels (Tier 2 EALs)

All DUs on the site exceeded background levels for total arsenic, so for purposes of analysis and decision-making in this Draft RAR (sections 4.0 & 5.0), the Hawaii DOH Tier 2 Soil Bio-accessible Arsenic guidance was used.

HDOH uses the following Arsenic Soil Management Categories for the evaluation and management of arsenic-contaminated soils (HDOH 2010, revised 2011 and 2012):

Category A Soils (natural background) - Soil (< 2 mm size fraction) exhibits concentrations of total arsenic ≤ 24 mg/kg and does not appear to have been impacted by local, agricultural or industrial release of arsenic; <u>Unrestricted Land Use</u>.

Category B Soils (minimally impacted) - Soil (< 2 mm size fraction) total arsenic >24 mg/kg, bioaccessible arsenic (< 250 µm size fraction) ≤23 mg/kg, indicating probable anthropogenic impacts but at levels within acceptable health risks for long-term exposure; <u>Unrestricted Land Use</u>.

Category C Soils (moderately impacted) - Soil (< 2 mm size fraction) total arsenic >24 mg/kg, bioaccessible arsenic (< 250 µm size fraction) > 23 mg/kg and ≤ 95 mg/kg; <u>Commercial/Industrial Land Use Only</u>.

Category D Soils (heavily impacted) - Soil (< 2 mm size fraction) total arsenic >24 mg/kg, bioaccessible arsenic (< 250 µm size fraction) > 95 mg/kg; <u>Removal/Remedial Action Required</u>.

A site-specific Removal Action Environmental Hazards Management Plan (Removal EHMP) for a removal action and an Environmental Hazards Management Plan (EHMP) for construction must be prepared when C or D soils are present on a property. An additional long-term Site EHMP must be prepared for post-construction conditions for all sites where C or D soils are proposed as left-in-place as the selected long-term management option. Each EHMP must be prepared for a specific removal action or a specific development scenario. For development, the EHMP must be based on site-specific architectural/engineering drawings. No EHMPs are required to be part of this Draft RAR or the Final RAR, but must be prepared prior to a removal action or site development, and must be approved for implementation by Hawaii DOH.

3.2 Conceptual Site Model (CSM)

The CSM considers the possible exposure pathways to human and ecological receptors. Unique chemical characteristics of a particular compound determine the routes of human or ecological exposure. The potential hazards for arsenic were evaluated using the Hawaii DOH EAL "Surfer" tools (HDOH 2016; HDOH 2016 rev Jan 2017). Hawaii DOH guidance recommends evaluation of soil environmental hazards including direct human contact (ingestion, dermal absorption, and inhalation), vapor emissions to indoor air, terrestrial ecotoxicity, gross contamination, and leaching (potential to impact ground water).

The potential human health hazard for arsenic in soil at the Property is <u>direct exposure</u>. For purposes of this CSM, "direct exposure" means direct ingestion of soil matter or inhalation of soil dust. Arsenic is non-volatile under environmental conditions of temperature and pressure found in natural soils, and therefore vapor emission is not a concern. Mobility of arsenic is not significant in Hawaii volcanic soils due to strong chemical bonding with naturally-occurring iron compounds, and therefore does not present a significant leaching hazard.

Terrestrial ecotoxicity is site-specific. Terrestrial ecotoxicity refers to the ability of a contaminant to damage an ecological population, ecological community, or ecosystem. In ecological terms, "population" means a number of individuals of the same species occupying the same ecological region; "community" means two or more populations co-existing within the same ecological region; "ecosystem" means two or more communities co-existing within the same region, and includes the abiotic elements of water, soils, climate and the geologic base.

Site development for Parcels 17&19 will be similar in character to the surrounding urban commercial/residential development, and this will severely restrict habitat to support feeding and nesting of terrestrial ecological receptors. No endangered species or sensitive habitats are reasonably expected to be at or near this urban-commercial project area. Therefore, ecotoxicity hazards are not a significant concern for this site.

The potential for arsenic-contaminated soil to be eroded or discharged to nearby surface waters does exist for a removal action or construction phase of development. However, erosion control measures will be specified during removal or construction activities to reduce to insignificant, or eliminate, this potential hazard. These measures will be part of the required EHMPs.

The potential for generation of arsenic-contaminated soil dust does exist for a removal or construction phase of development. However, dust control measures will be specified during removal/construction to reduce to insignificant, or eliminate, this potential hazard.

A National Pollutant Discharge Elimination System (NPDES) General Permit Coverage is required for a removal action or construction that exceeds 1 acre in extent. This permit will require operational and engineering controls to minimize the potential for release of soil from the site as stormwater runoff or as fugitive dust.

To remain consistent with current zoning, a future project will likely consist of a commercial/retail operation with buildings, paved parking areas, and delineated ornamental landscaping. These features will isolate and encapsulate all soils on site. Engineering and administrative controls will be in place in accordance with the long-term EHMP. Thus, the generation of fugitive dust and erosion materials will not be of concern for long-term operations on the Property.

For Alternatives 2 & 3 (section 4.0), standard landscaping features as required by the Hawaii County Planning Department are proposed to contain Category C soils and D soils that will remain on the Property following construction. These features are shown in Appendix G. The long-term EHMP will specify controls and practices that must be in place and complied with to protect business employees and patrons and the public from exposure to these soils over the long term.

Alternative 4 (section 4.0), addressed only removal of Category D soils from the Property and appropriate interim management of Category C soils that will remain on site. Any future site development will be coordinated with HDOH HEER Office to further address the containment and long-term management of Category C soils that will remain on the Property.

3.3 Environmental Hazard Evaluation – Arsenic

Arsenic in soil at the site mainly originated from *canec* manufacturing. Minor contributions may have come from use of pesticides on building peripheries, or from termite control, but as discussed in the *Phase I ESA Update* (*NES* 2017) there is no evidence to support that pesticides use was extensive. Arsenic is the 20th most abundant element in the Earth's crust and is naturally present in volcanic basalts, so naturally-occurring arsenic contributes to soil arsenic at this site.

Arsenic is a potential hazard to human health through ingestion and/or inhalation of dust. Potential receptors include construction workers, the public, and long-term business employees and patrons.

Arsenic in soil can present a hazard for children who may be exposed through "*pica*" behavior (inclination to eat non-food items such as dirt) or via outdoor play (CDC 2011).

Arsenic exposure can occur through poor hygienic practices, e.g., eating with unwashed soil-contaminated hands or from soil-contaminated clothing taken home where it may contaminate household members.

Arsenic is not a vapor inhalation hazard. Arsenic does not volatilize under ambient environmental conditions.

Arsenic is not considered a contact hazard because it is not absorbed significantly through skin.

Exposure to arsenic through inhalation of contaminated dust can occur from workers inadvertently breathing dust during weed-cutting operations for landscape maintenance. Dust exposure during planned construction activities can be minimized through the use of best management practices designed to suppress the generation of dust.

The highest total arsenic concentration found on the property was 1333 mg/kg. Bioaccessible arsenic in Property soils ranged from 0.30-234 mg/kg (Figure 1).

<u>Direct Exposure</u>
Direct exposure hazards to human health involve direct ingestion of contaminated soil or inhalation of dust generated from contaminated soil.

The arsenic direct-exposure hazard for future users of the Property must be mitigated and must be the basis for removal action decisions. The alternatives considered and evaluated to achieve exposure mitigation are discussed in sections 4.0 and 5.0.

Leaching

The potential for arsenic to leach in Hawaii's volcanic soils is low. Leaching refers to the movement of contaminants by dissolution in water and percolation through soil in the vadose zone (unsaturated zone) and potentially into underlying groundwater. Leaching potential is governed by chemical-specific properties and site-specific soil characteristics. Chemical species that are highly soluble in water and do not sorb strongly to soil compounds are considered "mobile" and have the highest leaching potential. Compounds with low water solubility and that bind strongly to soil compounds have low leaching potential. Walker (2004) analyzed the sample with the highest total arsenic concentration from the Property for the Toxicity Characteristic Leaching Potential (TCLP). The result was significantly lower than the federal maximum concentration of the toxicity characteristic of 5.0 mg/L for arsenic. This finding is consistent with expectations that arsenic is strongly adsorbed on high iron-oxide content volcanic soils, and is therefore essentially immobilized in Hawaii's volcanic soils. This is corroborated by elevated arsenic levels at numerous Hawaii sites of former arsenic use; after many decades of high rainfall conditions typical of the Hamakua coast and other areas of Hawaii (80-200+ inches annually) where arsenic is still found at elevated levels in soils.

Hazard Reduction Actions, pre-Removal Action

Until a removal action is conducted to address the hazard of direct contact with arsenic, persons should avoid contact with and removal of contaminated soil from Parcels 17&19. The current Property owner provides security services to monitor access and to enforce against trespass. Ground-level vegetation cover will be maintained at the site to reduce the potential for direct human contact with the soil, eliminate the potential for fugitive dust, and limit erosion.

4.0 REMOVAL ACTIONS

Soils on Parcels TMK (3) 2-2-30: 17&19 that contain arsenic at levels that meet or exceed Hawaii DOH criteria for Category C & D soils present a potential direct exposure risk to short-term removal/construction workers and future long-term business employees and patrons, and general public. Based on the hazard evaluation (section 3.0) BMPs during removal/construction are appropriate to mitigate short-term risks to workers. Excavation/disposal or isolation/encapsulation on-site for contaminated soils are appropriate solutions to minimize or eliminate short-term and long-term risks from arsenic exposure for human and ecological receptors.

Removal actions presented below propose the restriction to Commercial/Industrial land use for the Property, consistent with current zoning. This will allow protective long-term management of Category C soils on site, and will avoid the excessive mitigation costs to bring the site into regulatory compliance with Category A or B criteria.

An evaluation of removal alternatives was prepared to determine the most advantageous approach for a removal action. Discussions of Removal Action Objectives (RAOs) and Removal Action Alternatives (RAAs) are presented below.

4.1 Removal Action Objectives (RAO)

The over-arching goal of a removal action on the Property is to protect human and ecological receptors from arsenic exposure, during a removal action and after site development. Specific objectives to achieve this goal are:

- Remove arsenic-contaminated soils from the site, or isolate these soils under vegetation/soil cover or in on-site containment cells;

- Protect workers from direct exposure to arsenic during a removal action and construction;

- Prevent migration of arsenic-contaminated soil to off-site adjacent land locations;

- Prevent migration of arsenic-contaminated soils to surface waters;

- Protect business employees and patrons and general public from arsenic exposure over the long-term.

4.2 Removal Action Alternatives (RAA)

Based on the RAOs, four (4) RAAs were developed for consideration.

Because leaching of arsenic and impact to groundwater does not represent a hazard, and there is no significant arsenic risk to terrestrial plant or animal species, removal alternatives consist of proven methods to eliminate potential for direct human contact with arsenic. Removal actions are thus limited to:

- remove soils from site;
- isolate/encapsulate soils on-site.

The top approximately 12 inches of soil on this site is “overburden”. This overburden soil is highly organic and is not suitable for support of pavements or structures, and must be managed accordingly for any proposed development. Geotechnical considerations for engineering/construction require removal of the overburden layer where pavement or structures will be located. Investigations indicate that arsenic contamination is likely limited to this layer. Therefore, the presence of arsenic in the soil super-imposes an arsenic management requirement on an existing engineering requirement.

Alternative 1 - No Action

This alternative does not meet the RAOs and is included for baseline comparison purposes only. Under this alternative the Property will remain in the present-day condition and the current level of risk for human and ecological receptors will remain unchanged.

Alternative 2 - Excavation and Off-site Disposal of D Soil; On-site Containment of C Soils; Full-scale Fill/Grading Site Development in Near-term

This alternative requires full-scale fill and grading site development in the near-term to allow for construction of landscaping features that will serve as containment cells for Category C soils that will remain on-site. Landscaping features extend throughout the site and must be integrated with finished grade construction. Full-scale fill and grading site development is therefore required to implement this alternative. Paving, utilities, and building foundations are not required to implement this alternative and are not included in the cost estimate.

Isolation/encapsulation of Category C soil *in situ* is a viable option because arsenic in Hawaii soils does not leach appreciably and is not expected to bio-accumulate to a significant extent in terrestrial plants found at this site.

See Figure 1, Appendix D, and Appendix G for reference to location of Decision Units (DUs), landscaping features, site dimensions, and soil depths.

- Category D soils (DU1) – Excavate soil to approximately 12 inches below ground surface and dispose at RCRA-compliant West Hawaii Sanitary Landfill. Conduct confirmation sampling to determine residual arsenic concentration in exposed subgrade. If Category C or higher bio-accessible soils remain, remove additional soils to bedrock and dispose at the landfill, or place grid of labelled warning tape on exposed subgrade (10-20 ft spacing), cover exposed subgrade with engineered fill to finished grade (sub-base and base course aggregate), and document estimated depth of fill for the Site Environmental Hazards Management Plan (Site EHMP). Rock/soil will remain in place under

(Alt 2 cont'd)

clean fill of suitable thickness, with vegetation cover or encapsulation with impermeable pavement and structural concrete, depending on final site architecture and landscaping.

- Category C soils (DU2) – Excavate soil to approximately 12 inches below ground surface and stock-pile on-site for later placement in on-site containment cells. If Category C soils remain, place grid of labelled warning tape on exposed subgrade (10-20 ft spacing). Cover exposed subgrade with engineered fill to finished grade (sub-base and base course aggregate). Document the depth of fill for the Site EHMP. Rock/soil will remain in place under clean fill of suitable thickness, with vegetation cover or encapsulation with impermeable pavement and structural concrete, depending on future site architecture and landscaping.

- Category C soils (stock-piled from DU2) – Stock-piled material to be placed in the bottom (4 feet) of on-site containment cells (Figure 3 and Appendix G). Cover C soil with geotextile to delineate C soil surface. Cover C soil in containment cell with approximately 12 inches of B soil (Figure 3).

- Category C soils (DU7 Deep) – After excavation of surface B soils place labeled warning tape on exposed subgrade (10-20 ft spacing). Cover exposed subgrade with engineered fill (sub-base and base course aggregate) to finished grade. Document the depth of fill for the Site EHMP. Rock/soil will remain in place under clean fill of suitable thickness, with vegetation cover or encapsulation with impermeable pavement and structural concrete, depending on final site architecture and landscaping.

- Category B soils (DU3-7 Shallow) - Excavate organic materials and place on the top 1 foot of on-site containment cells (Figure 3) as isolation barrier to C soils beneath. Remaining volume of B soils that must be removed from site for geotechnical considerations for engineering/construction to be disposed off-site (East Hawaii Organic Facility) or marketed and sold as soil amendment.

(Alt 2 cont'd)

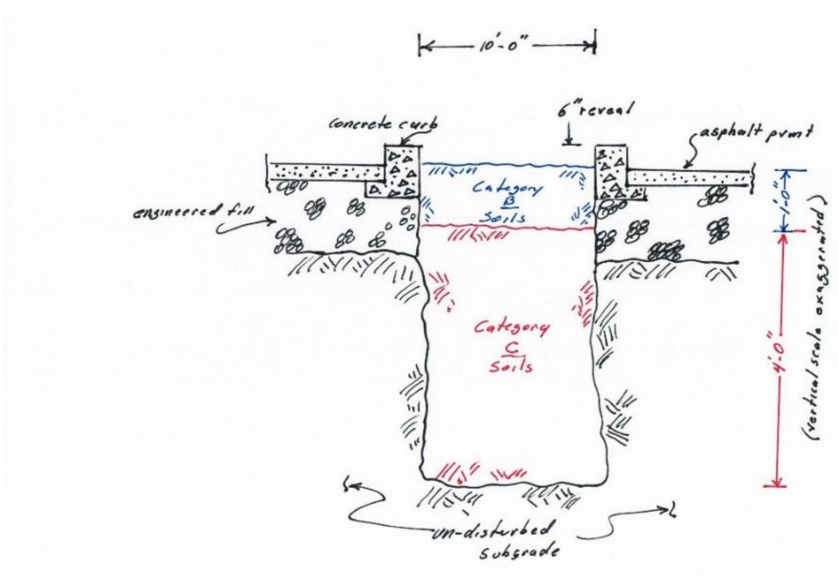


Figure 3. Cross-section – on-site containment cell for Alternative 2

<u>Calculations (Alt 2)</u>

Volume D soil (DU1) = 2155 cubic yards
Volume C soil (DU2) = 1860 cubic yards
Volume C soil (DU7 Deep) = 765 cubic yards
Volume B soil (DU3-7 Shallow) = 6050 cubic yards

Note: Volumes are calculated based on average soil depth not expected to exceed 12 inches.

Available containment cell (landscaping feature) = 1300 linear ft.

Note: Taken from conceptual site plan Appendix G.

Volume of available containment cell (total)
= 1300 ft x 10 ft wide x 5 ft deep ÷ 27
= 2410 cubic yards

Note: Standard landscaping feature per Hawaii County Planning Dept (10 ft wide x 5 ft deep).

Volume of available containment cell (for C soil from DU2)
= 1300 ft x 10 ft wide x 4 ft deep ÷ 27
= 1925 cubic yards

Note: Adequate volume to receive all DU2 C soil for containment.

Volume of available containment cell (for B soil from DU3 -7 Shallow)
= 1300 ft x 10 ft wide x 1 ft deep ÷ 27
= 485 cubic yards

Note: Remaining B soil = 5600 cubic yards to be disposed off-site.

(Alt 2 cont'd)

Cost Estimate (Alt 2)

○ Dispose DU1 D soil = 2155 cubic yards x $125 per cubic yard =	$269,375
○ Stock-pile DU2 C soil = 1860 cubic yards x $10 per cubic yard =	$18,600
○ Conduct confirmation sampling (consultant & laboratory) =	$2500
○ Install warning tape at 10-20 ft grid pattern at C soil interface =	$10,000
○ Prepare Removal/Construction EHMP (consultant) =	$5000
○ Prepare long-term Site EHMP (consultant) =	$5000
○ Full-scale fill/grading site development required to integrate landscaping features to be used for on-site containment cells for C soils =	$3,678,575
Total Cost Alternative 2 =	$3,989,050

Alternative 3 - On-site Containment of C & D soils; Full-scale Fill/Grading Site Development in Near-term

This alternative requires full-scale fill and grading site development in the near-term to allow for construction of landscaping features that will serve as containment cells for Category C & D soils that will remain on-site. Landscaping features extend throughout the site and must be integrated with finished grade construction. Full-scale fill and grading site development is therefore required to implement this alternative. Paving, utilities, and building foundations are not required to implement this alternative and are not included in the cost estimate.

Isolation/encapsulation of Category C soil *in situ* is a viable option because arsenic in Hawaii soils does not leach appreciably and is not expected to bio-accumulate to a significant extent in terrestrial plants found at this site.

Isolation/encapsulation of Category D soil *in situ* is a viable option because of limited arsenic leaching potential, and because D soils will be buried ~ 5 ft below the ground surface and removed from human access.

See Figure 1, Appendix D, and Appendix G for reference to location of Decision Units (DUs), landscaping features, site dimensions, and soil depths.

- Category D soils (DU1) – Excavate soil to approximately 12 inches below ground surface and stock-pile on-site for later placement in on-site containment cells. Conduct confirmation sampling to determine

(Alt 3 cont'd)

residual arsenic concentration in exposed subgrade. If Category C or higher bio-accessible soils remain, excavate additional soils to bedrock and stockpile, or place grid of labelled warning tape on exposed subgrade (10-20 ft spacing). Document the depth of fill for the Site EHMP. Cover exposed subgrade with engineered fill to finished grade (sub-base and base course aggregate). Rock/soil will remain in place under clean fill of suitable thickness, with vegetation cover or encapsulation with impermeable pavement and structural concrete, depending on final site architecture and landscaping.

- Category C soils (DU2) – Excavate soil to approximately 12 inches below ground surface and stock-pile on-site for later placement in on-site containment cells. If Category C soils remain, excavate additional soils to bedrock and stockpile, or place grid of labelled warning tape on exposed subgrade (10-20 ft spacing), cover exposed subgrade with engineered fill to finished grade (sub-base and base course aggregate), and document the estimated depth of fill for the Site EHMP. Underlying rock/soil will remain in place under clean fill of suitable thickness, with vegetation cover or encapsulation with impermeable pavement and structural concrete, depending on final site architecture and landscaping.

- Category C & D soils (stock-piled from DU1 & DU2) – Stock-piled material to be placed in the bottom (5 ft for D and 4 ft for C) of on-site containment cells (Figure 4). Cover C & D soil surfaces in cell with geotextile to delineate soil surfaces. Cover C soil in containment cell with approximately 12 inches of B soil (Figure 4). Appropriate long-term management of these soils will be documented and implemented in accordance with the Site EHMP.

- Category C soils (DU7 Deep) – After excavation of surface B soils place labeled warning tape on exposed subgrade (10-20 ft spacing). Cover exposed subgrade with engineered fill (sub-base and base course aggregate) to finished grade. Document the estimated depth of fill for the Site EHMP. Underlying rock/soil will remain in place under clean fill of suitable thickness, with vegetation cover or encapsulation with impermeable pavement and structural concrete, depending on future site architecture and landscaping. Appropriate long-term management

(Alt 3 cont'd)

of these soils will be documented and implemented in accordance with the Site EHMP.

- Category B soils (DU3-7 Shallow) - Excavate organic materials and place on the top 1 foot of on-site containment cells (Figure 4) as isolation barrier to C & D soils beneath. Remaining volume of B soils that must be removed from site for geotechnical considerations for engineering and construction to be disposed off-site (East Hawaii Organic Facility) or marketed and sold as soil amendment.

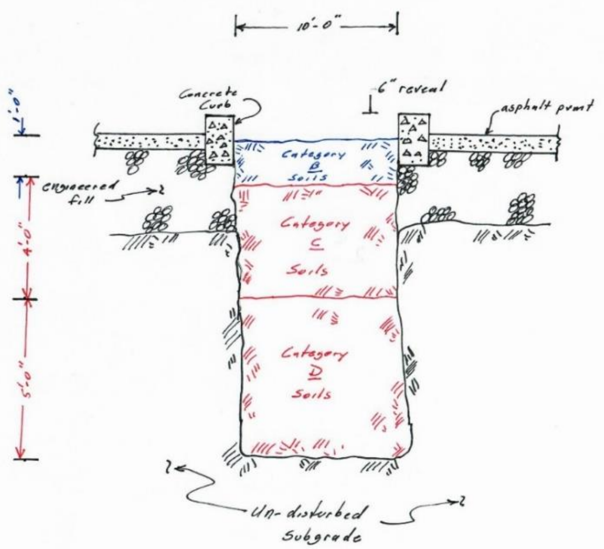


Figure 4. Cross-section – on-site containment cell for Alternative 3

<u>Calculations (Alt 3)</u>

Volume D soil (DU1) =	2155 cubic yards
Volume C soil (DU2) =	1860 cubic yards
Volume C soil (DU7 Deep) =	765 cubic yards
Volume B soil (DU3-7 Shallow) =	6050 cubic yards

Note: Volumes are calculated based on average soil depth not expected to exceed 12 inches.

Available containment cell (landscaping feature) = 1300 linear ft.

Note: Taken from conceptual site plan Appendix G.

(Alt 3 cont'd)

Volume of available containment cell (total)
= 1300 ft x 10 ft wide x 10 ft deep ÷ 27
= 4815 cubic yards
Note: Exceeds standard landscaping feature per Hawaii County Planning Dept (10 ft wide x 5 ft deep); high likelihood of construction contingency for 10 ft excavation in lava substrate.

Volume of available containment cell (for D soil from DU1)
= 1300 ft x 10 ft wide x 5 ft deep ÷ 27
= 2405 cubic yards
Note: Adequate volume to receive all DU1 D soil for containment.

Volume of available containment cell (for C soil from DU2)
= 1300 ft x 10 ft wide x 4 ft deep ÷ 27
= 1925 cubic yards
Note: Adequate volume to receive all DU2 C soil for containment.

Volume of available containment cell (for B soil from DU3 -7 Shallow)
= 1300 feet x 10 feet wide x 1 foot deep ÷ 27
= 485 cubic yards
Note: Remaining B soil = 5600 cubic yards to be disposed off-site.

<u>Cost Estimate (Alt 3)</u>

- Stock-pile DU1 D soil = 2155 cubic yards x $10 per cubic yard = $21,550
- Stock-pile DU2 C soil = 1860 cubic yards x $10 per cubic yard = $18,600
- Excavate additional containment volume for DU1 D soil
  = 2155 cubic yards x $55 per cubic yard = $118,525
- Place D soil in containment, 2155 cubic yards x $27 per cubic yard = $58,185
- Construction contingency for 10 ft depth excavation (lump sum) = $150,000

Note: Contingency should be carried as a *bona fide* cost, due to high likelihood of construction difficulties for 10-foot deep excavation in non-cohesive native lava substrate. Validated by discussion with experienced general contractors.

- Conduct confirmation sampling (consultant & laboratory) = $2500
- Install warning tape at 10-20 foot grid pattern at C & D soil interface= $12,000
- Prepare Removal/Construction EHMP (consultant) = $5000
- Prepare long-term Site EHMP (consultant) = $5000
- Full-scale fill/grading site development required to integrate landscaping features to be used for on-site containment cells for C & D soils = $3,678,575

Total Cost Alternative 3 = $4,069,935

Alternative 4 – Excavation and Off-site Disposal of D soils; *In situ* Management of C Soils in Near-term; Phased Site Development (Future)

This alternative does not require site development of any scale in the near-term. The main objective of this alternative is to remove Category D soils from the site. Removal of D soils will set conditions for later commercial/industrial phased development of the Property. Remaining Category C soils will be managed under protective vegetative cover and interim institutional controls detailed in a Site EHMP. Future additional containment and long-term management of C soils that will remain on-site will be the subject of later regulatory engagement with Hawaii DOH and in accordance with the Site EHMP.

Isolation/encapsulation of Category C soil *in situ* is a viable option because arsenic in Hawaii soils does not leach appreciably and is not expected to bio-accumulate to a significant extent in terrestrial plants found at this site. Also, the presence of Category C soils is permissible for commercial and industrial development according to Hawaii DOH Tier 2 guidance.

See Figure 1, Appendix D, and Appendix G for reference to location of Decision Units (DUs), landscaping features, site dimensions, and soil depths.

- Category D soils (DU1) – Excavate soil to approximately 12 inches below ground surface and dispose at RCRA-compliant West Hawaii Sanitary Landfill. Conduct confirmation sampling to determine residual arsenic concentration in exposed subgrade. If Category C or higher bio-accessible soils remain, excavate additional soils to bedrock and dispose at the landfill, or place a grid of labelled warning tape on exposed subgrade (10-20 ft spacing), cover exposed subgrade with minimal engineered fill (sub-base course aggregate), and document estimated depth of fill for the Site EHMP. Rock/soil will remain in place under clean fill of suitable thickness, with vegetation cover or encapsulation with impermeable pavement and structural concrete, depending on future site architecture and landscaping.

- Category C soils (DU2) – Soil and underlying rock will remain in place, undisturbed from present condition, with vegetation cover and interim institutional controls (documented in a Site EHMP) until phased future development is planned and implemented. Future development will require coordination and approval from Hawaii DOH HEER Office, when

(Alt 4 cont'd)

Category C soils are planned to be further contained and included in the long-term management plan (long-term Site EHMP) for the site.

- Category C soils (DU7 Deep) – Soil and underlying rock will remain in place, protected and undisturbed from present condition, with vegetation cover until phased future development is planned and implemented. Future development will require coordination and approval from Hawaii DOH HEER Office because of presence of Category C soils at depth. These soils will be included and managed under the long-term management program for the site (long-term Site EHMP).

Calculations (Alt 4)

Volume D soil (DU1) =	2155 cubic yards
Volume C soil (DU2) =	1860 cubic yards
Volume C soil (DU7 Deep) =	765 cubic yards

Note: Volumes are calculated based on average soil depth not expected to exceed 12 inches.

Cost Estimate (Alt 4)

○ Dispose DU1 D soil = 2155 cubic yards x $125 per cubic yard =	$269,375
○ Conduct confirmation sampling (consultant & laboratory) =	$2500
○ Prepare Removal EHMP (consultant) =	$5000
○ Prepare Site EHMP (consultant) =	$5000
○ Conduct TCLP for West Hawaii Sanitary Landfill requirement =	$2500
○ Contingency (10%) for limited tipping schedule for disposal of D soil at West Hawaii Sanitary Facility (hours of operations are limited) =	$28,450
Total Cost Alternative 4 =	$312,825

4.3 Evaluation Criteria

Removal Action Alternatives (*Alt 1*, *Alt 2, Alt 3* & *Alt 4*) were evaluated using 5 performance criteria:

- Achieves RAOs

- Meets Regulatory Requirements

- Effectiveness, a measure of:
  - will the action achieve overall protection of human health and the environment over the short-term and long-term;
  - will the action achieve compliance with regulatory requirements;

  - will the action meet RAOs.

- Feasibility, considers a variety of factors, including:
  - constructability;
  - technical and administrative feasibility;
  - suitability of land for future uses;
  - implementation complexity;
  - time-frame to implement;
  - will the action allow construction of zoned development to advance.

- Cost considers a variety of factors, including:
  - total cost to implement the removal action;
  - soil disposal costs;
  - costs typical to construction for any development, regardless of presence of contamination;
  - additional costs specific to the removal action;
  - regulatory requirements for confirmation sampling;
  - regulatory requirements for preparation of EHMPs;
  - integration of on-site management of C & D soils with standard and typical construction practices and techniques;
  - incidental earthwork such as imported fill and compaction that are part of typical construction, or watering for dust control and installation of berms and silt fences to control erosion.

5.0 REMOVAL ACTIONS ALTERNATIVES ANALYSIS

5.1 Alternative 1 - No Action

The No Action alternative, included as a comparative baseline, consists of no removal actions and no development, and the site will be left in the present-day condition. Under this alternative no engineering features or institutional controls (containment cells, signage, deed notices, etc.) are employed to prevent potential human or ecological risks for exposure to arsenic-impacted soils.

Effectiveness

The No Action alternative will not achieve RAOs, will not protect human and ecological receptors against direct contact with arsenic-impacted soils, and will not meet regulatory requirements to provide for future commercial/industrial development on the Property.

Feasibility

There is no discussion of feasibility because no action is planned.

Cost
There is no cost associated with the No Action alternative.

5.2 Alternative 2 – Excavation and Off-site Disposal of D Soils; On-site Containment of C Soils; Full-scale Fill/Grading Site Development in Near-term

Effectiveness
Excavation and off-site disposal of Category D soils and on-site containment of C soils that exceed the Commercial/Industrial land use EAL will be an effective long-term remedy and fully meet RAOs and regulatory compliance requirements.

The Property is expected to remain in commercial zoning and is not likely to be used for future residential re-development. Residential development would require a zoning change to a commercial section of downtown Hilo and a substantial regulatory compliance burden for a developer.

Feasibility
All engineering and construction components of this alternative are readily implementable using standard environmental management and civil engineering construction techniques. Dust control and soil erosion control measures will be implemented during soil excavation, relocation, and grading activities to prevent fugitive dust and contaminant migration via erosion.

The excavation and off-site disposal of Category D soil can be implemented using traditional construction techniques. This alternative is simple in approach, i.e., “dig and haul”, and effective. Dust control and soil erosion control measures must be implemented during excavation and loading activities to ensure worker and community health and safety. These requirements will be addressed through the Removal/Construction EHMP. Approximately 200 truck-loads of soil will be transported over local roadways, resulting in short-term increased truck traffic and potential neighborhood disturbances over the short-term.

The excavation and relocation of Category C soils to on-site containment cells is technically feasible and effective. Architectural/engineering design and construction plans will be the basis of an HDOH-approved Removal/Construction EHMP that will be prepared in advance of work to ensure proper implementation.

Cost
The total estimated cost for Alternative 2 ($3,989,050) includes the anticipated cost for full-scale fill and grading on the Property. This cost is considered prohibitive.

Full-scale fill and grading site development is necessary to provide the on-site containment cells that are integral with earthwork and that must be in place to achieve containment of C soils.

5.3 Alternative 3 – Excavation and On-site Containment of C & D soils; Full-scale Fill/Grading Site Development in Near-term

Effectiveness

On-site containment of C & D soils that exceed the Commercial/Industrial land use EAL could be an effective long-term remedy and fully meet RAOs and regulatory requirements, if significant constructability challenges can be overcome. However, there is not substantial confidence in this speculation, as discussed under *feasibility* below.

The Property is expected to remain in commercial zoning and is not likely to be used for future residential re-development. Residential development would require a zoning change to a commercial section of downtown Hilo and a substantial regulatory compliance burden for a developer.

Feasibility

The excavation and on-site containment of Category C & D soil may not be implementable using traditional construction techniques. This alternative is likely not simple in approach. Constructability of a 10-ft excavation as part of the landscaping feature remains equivocal. This depth of excavation in the lava substrate may result in significant and persistent collapse of excavation sides due to the non-cohesive nature of the highly fractured material. Maintaining excavation lines and grades to achieve containment cell dimensions may require specialized techniques for trenching and shoring. Future subsidence due to excavation instability and the decomposition of organic matter at depth is also a concern. At this time, there is no way to further characterize uncertainties in constructability for this alternative. A detailed engineering design and a detailed construction methodology from an experienced construction contractor is required before this issue can be discussed further.

Cost

The total estimated cost for Alternative 3 ($4,069,935) includes the anticipated cost for full-scale fill and grading for the Property. This cost is considered prohibitive. Full-scale fill and grading for the site is necessary to provide the on-site containment cells that are integral with earthwork, and that must be in place to achieve containment of C & D soils. However, there are significant uncertainties associated with this cost estimate, due to the constructability issues. Moreover, there are no practical advantages to D soils remaining on-site compared to Alternative 2. Therefore the increased cost and uncertainty in constructability are not justifiable by comparison.

5.4 Alternative 4 – Excavation and Off-site Disposal of D soils; *In situ* Management of C Soils in Near-term; Phased Site Development (Future)

Effectiveness

Excavation and off-site disposal of Category D soils will be an effective long-term remedy and fully meet RAOs and regulatory compliance requirements.

The Property is expected to remain in commercial zoning and is not likely to be used for future residential re-development. Residential development would require a zoning change to a commercial section of downtown Hilo and a substantial regulatory compliance burden for a developer.

Category C soils that will remain on-site in DU2 and DU7 Deep will remain effectively isolated from the public, under institutional controls to prevent potential future exposures or disturbances.

Implementation of this alternative will effectively set conditions for future planned and implemented commercial/industrial development.

Feasibility

All engineering and construction components of this alternative are readily implementable using standard environmental management and civil engineering construction techniques.

The excavation and off-site disposal of Category D soil can be implemented using traditional construction techniques. This alternative is simple in approach, i.e., "dig and haul", and effective. Dust control and soil erosion control measures must be implemented during excavation and loading activities to ensure worker and community health and safety. These requirements will be addressed through the Removal Action Work Plan. Approximately 200 truck-loads of soil will be transported over local roadways, resulting in short-term increased truck traffic and potential neighborhood disturbances over the short-term.

Cost

The total estimated cost for Alternative 4 ($312,825) is considered a reasonable and acceptable economic expenditure for the benefits gained by removal of D soils from the Property.

5.5 Comparison of Alternatives and Recommendation

Table 5.5 Comparison of Alternatives – Ratings[1]

Factor	***Alternative 1***	***Alternative 2***	***Alternative 3***	***Alternative 4***
Achieves RAOs	None	High	Low	High
Meets Regulatory Requirements	None	High	Low	High
Effectiveness	None	High	Low	High
Feasibility	None	High	Low	High
Cost	None ($0)	Low ($3,989,050)	Low ($4,069,935)	High ($312,825)

[1]Note:
"None" = does not meet RAOs, evaluation criteria, or regulatory requirements
"Low" = does not support sufficient confidence that RAOs, evaluation criteria, and regulatory requirements will be fully met
"High" = supports greatest confidence to fully meet RAOs, evaluation criteria, and regulatory requirements

Based on comparisons, the recommended removal action is ***Alternative 4***.

6.0 IMPLEMENTATION OF RECOMMENDED ALTERNATIVE (*Alternative 4*)

6.1 Removal EHMP for the Recommended Removal Action

Following HDOH concurrence on the Final RAR, a Removal EHMP must be prepared and provided to HDOH. This EHMP will stipulate actions that must be complied with during the removal of Category D soils, to protect workers and the public, and to ensure that the removal action is implemented correctly. This EHMP must be prepared and submitted to HDOH for review, comment, and approval before commencing work. Remaining Category C soils will be managed under appropriate interim institutional controls (documented in a Site EHMP) until further containment during future site development, and eventually long-term management under a long-term Site EHMP.

An NPDES Permit for the removal action is required and permit stipulations must be complied with during removal activities. The NPDES permit is issued by HDOH Clean Water Branch.

6.2 Project Close Out

Close-out of Alternative 4 will entail the issue of a *No Further Action with Institutional Controls* letter (NFA) from Hawaii DOH HEER Office. The NFA letter will officially concur that Category D soils were removed from the site and that the site is left in an acceptable condition.

7.0 PUBLIC REVIEW AND COMMENT PROCESS

Following Draft RAR approval by HDOH (HEER Office), public engagement will be conducted. A Public Notice will be published in the Hawaii Tribune Herald and on the HEER Office website. The Public Notice will indicate where project documents are available for public review, and how to return comments to HEER Office. A Fact Sheet containing pertinent information on the project, hazards, and removal alternatives will be prepared as part of public engagement. The Public Notice and Fact Sheet will be distributed to surrounding residents via the US Postal Service at the beginning of the 30-day public review and comment period.

An evening Public Meeting will be scheduled in the middle of the 30-day public review and comment period, to present details of the recommended removal action, to answer questions on the Draft RAR, and to take comments from the public. Due to the schedule of the Public Meeting in the middle of the comment period, anyone in attendance will have an opportunity to submit additional comments before the period ends.

Following public engagement, the Final RAR will be prepared for HEER Office concurrence. The Final RAR will identify the final removal alternative approved by HDOH, will summarize public comments received, and will provide responses to the comments. Summary of comments and responses will be prepared by HDOH HEER Office. Hawaii DOH will provide an official letter of Final RAR approval to the prospective purchaser or land owner for the selected removal action.

8.0 DESCRIPTION OF HAZARDOUS WASTE REMAINING ON-SITE

Approximately 2625 cubic yards of Category C soil will remain on the Property as part of implementation of the recommended Alternative 4. This soil will remain isolated *in situ*, under vegetation cover (DU2) and overlying soil (DU7 Deep), until development is proposed and implemented at a later date. Institutional controls will be documented in a Site EHMP to prevent exposures or disturbances to

Category C soils until this soil is further contained during future site development. The Site EHMP will be updated for long-term management of Category C soils once they are in a final containment area.

No other hazardous waste or other contaminated materials will remain on the Property following implementation of Alternative 4.

9.0 CONCLUSIONS AND RECOMMENDATIONS

Hilo Property TMK (3) 2-2-30:17 & 19 is vacant land with Category B, C and D soils according to HDOH criteria for arsenic contamination. The sole Recognized Environmental Condition for the Property is arsenic-impacted soils. Alternative 4 is the recommended alternative to achieve removal objectives in a cost-effective manner.

Excavation of D soils from DU1 with disposal at the RCRA-compliant West Hawaii Sanitary Land Fill, combined with *in situ* isolation of C soils from DU2 and DU7 Deep represent a technically sound removal scheme. When these actions are managed through HDOH-approved Removal EHMP and Site EHMP, Alternative 4 will effectively reduce risk of arsenic exposure in human and ecological receptors in the short- and long-term.

The completion of Alternative 4 will transform a previously un-productive parcel of land in downtown Hilo into an economic advantage for the community, and will eliminate the present-day unmanaged risk of arsenic exposure in human and ecological receptors.

10.0 REFERENCES

Center for Disease Control and Prevention. 2011. Pica Behavior and Contaminated Soil.

Engott, J.A. 2011. A water-budget model and assessment of groundwater recharge for the Island of Hawai‘i: U.S. Geological Survey Scientific Investigations Report 2011–5078, 53 p.

Hawaii Department of Health. Summer 2016 rev. Nov 2016. EAL Surfer.

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Hawaii Department of Health. 2012. Update to Soil Action Levels for Inorganic Arsenic and Recommended Soil Management Practices. Office of Hazard Evaluation and Emergency Response, 37p.

Mink, J.F. and L.S. Lau. 1993. Aquifer identification and classification for the Island of Hawaii: groundwater protection strategy for Hawaii. Honolulu (HI): Water Resources Research Center, University of Hawaii at Manoa. WRRC Technical Report 191, 108 p.

State of Hawaii. 1963. Closing of Flintkote Company, Canec Division, Hilo, Hawaii: Department of Planning and Economic Development, 13 p.

Takasaki, K.J. 1993. Ground water in Kilauea Volcano and adjacent areas of Mauna Loa Volcano, Island of Hawaii: U.S. Geological Survey Open-File Report 93-82, 28 p.

11.0 SIGNATURES AND CERTIFICATION STATEMENT

Draft Removal Action Report preparers:

28 Nov 2017

Peter J. Peshut, PhD — Date
Environmental Scientist
Nimbus Environmental Services

28 Nov 2017

Edna L. Buchan, MSc — Date
Proprietor, Environmental Scientist
Nimbus Environmental Services

Environmental Professional Certification:

We declare that to the best of our professional knowledge and belief we each meet the definition of *Environmental Professional* as defined in 40 CFR § 312.10(b).

The Environmental Professionals who directed this project have the specific qualifications based on education, training, and experience to assess a site of the nature, history and setting of the Property. The professional qualifications of Dr. Peshut and Ms. Buchan are included in Appendix H. We have developed and conducted the All Appropriate Inquires in conformance with the standards and practices set forth in 40 CFR Part 312.

28 Nov 2017

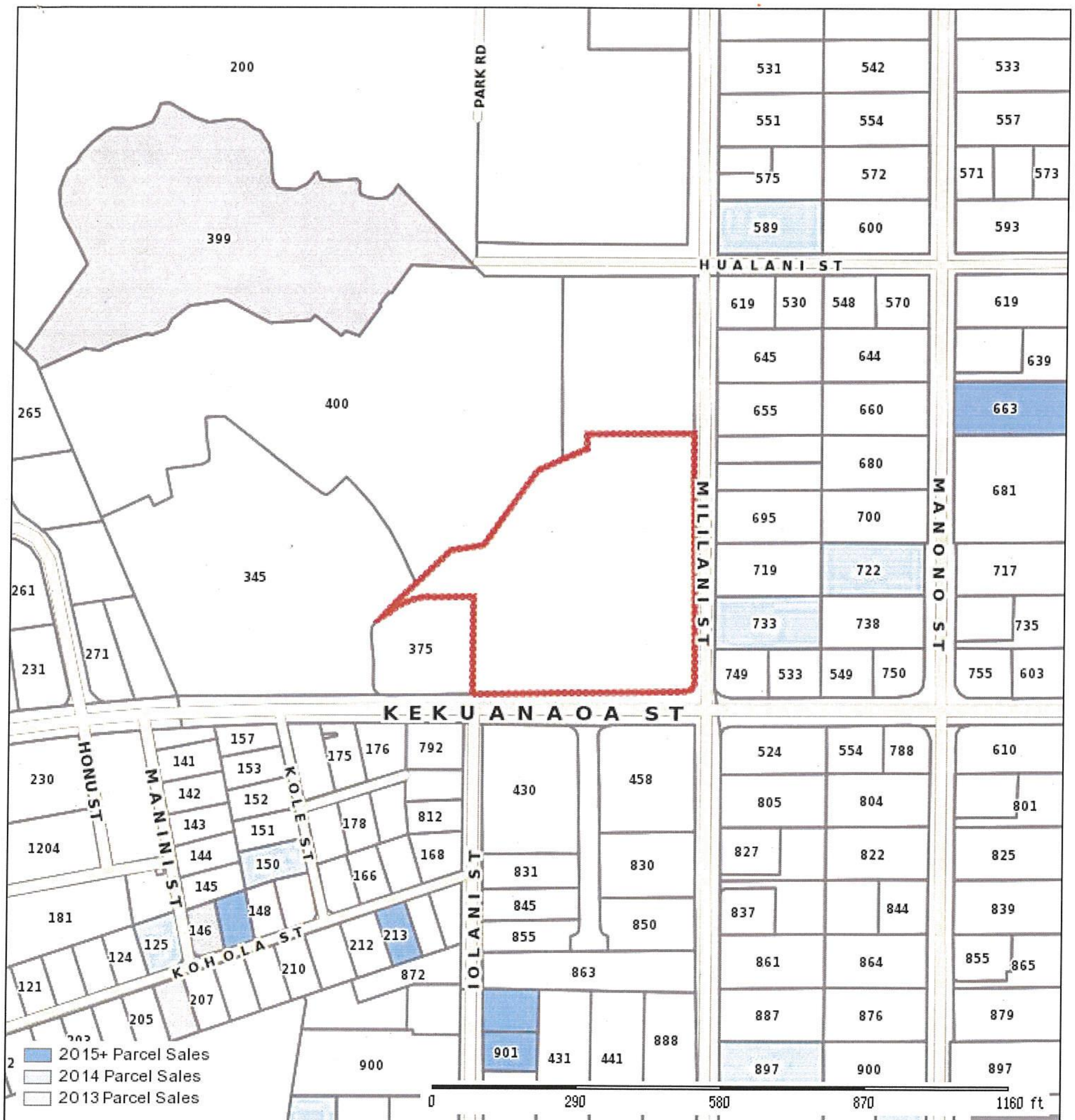
Peter J. Peshut, PhD — Date
Environmental Scientist
Nimbus Environmental Services

28 Nov 2017

Edna L. Buchan, MSc — Date
Proprietor, Environmental Scientist
Nimbus Environmental Services

APPENDIX A – Hawaii County Assessor Maps TMK (3) 2-2-30: 17 & 19

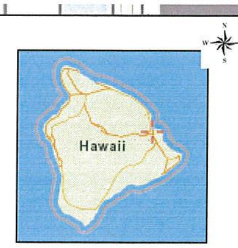
Hawaii County Assessor Map - Parcel 17



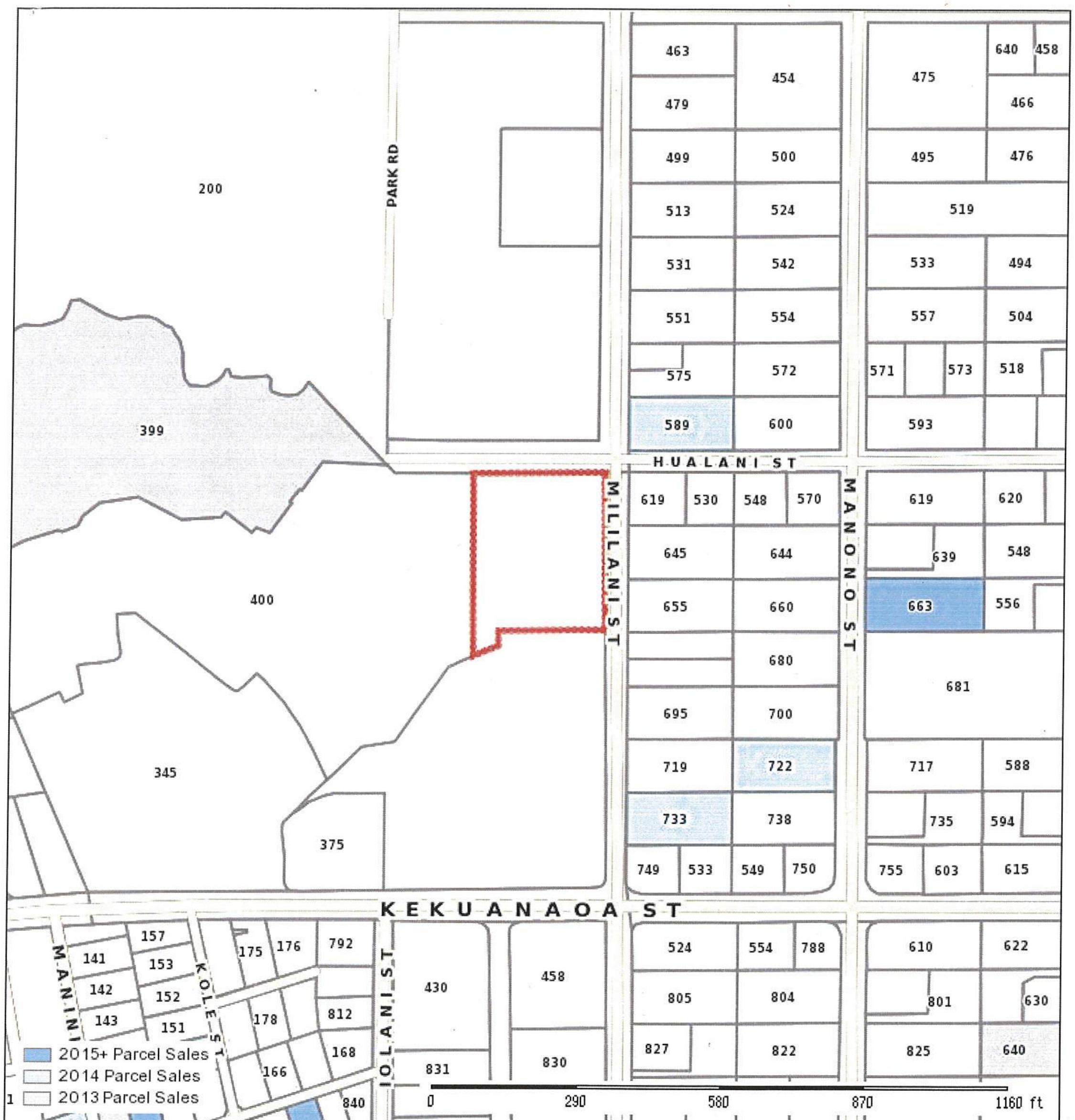
Hawaii County Assessor

Parcel: 220300170000 Acres: 4.4056

Name:	DE LUZ,DAVID S SR TRST	Land Value	1871100
Site:		Land Exemption	0
Sale:	$1765800 on 2012-08-07 Reason=0 Qual=	Taxable Land Value	1280000
Mail:	811 KANOELEHUA AVE HILO, HI 96720-5114	Building Value	0
		Building Exemption	0
		Taxable Bldg. Value	0
		Total Taxable Value	1280000



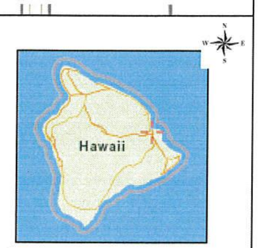
Hawaii County Assessor Map - Parcel 19



Hawaii County Assessor

Parcel: 220300190000 Acres: 1.8257

Name:	DE LUZ,DAVID STANLEY SR	Land Value	878800
Site:		Land Exemption	0
Sale:	$600000 on 2005-03-18 Reason=0 Qual=	Taxable Land Value	590000
Mail:	811 KANOELEHUA AVE HILO, HI 96720-5114	Building Value	20400
		Building Exemption	0
		Taxable Bldg. Value	20400
		Total Taxable Value	610400



APPENDIX B – Property Photographs TMK (3) 2-2-30: 17 & 19

Photo 1 - Corner Kekuanaoa & Mililani Streets, Looking West on Kekuanaoa

Photo 2 - Corner Kekuanaoa & Mililani Streets, Looking North on Mililani

Photo 3 - Southeast Corner of Property, Looking Northwest

Photo 4 - Southwest Corner of Property, Looking Northeast

Photo 5 - Northeast Corner of Property, Looking Southwest

Photo 6 - Northwest Corner of Property, Looking Southeast

APPENDIX C – USDA/NRCS Web Soil Survey TMK (3) 2-2-30: 17 & 19

NRCS Soil Maps – Parcels 17&19

APPENDIX D – *NES* Soil Investigation Report TMK (3) 2-2-30: 17 & 19

Nimbus Environmental Services

30 August 2016

David S. De Luz, Jr.
811 Kanoelehua Ave.
Hilo, HI 96720

Re: Soil Investigations for TMK (3) 2-2-30 17 & 19 (Kekuanaoa & Mililani Streets)

Dear Mr. De Luz:

This investigation was conducted following discussions with Hawaii DOH regarding assumptions for soil depth, substrate, and fill material on the subject parcels. A field investigation was conducted 27 August 2016 to determine soil thickness, presence of fill, and characteristics of underlying material.

A total of 15 locations were investigated for soil thickness and to describe the underlying base (Figure 1). Twelve (12) sites were investigated on parcel 17. Three (3) sites were investigated on parcel 19. In the field, locations were established by pacing a distance from reference points along the property boundaries. The locations shown in Figure 1 are estimated ± 20 feet from the actual location in the field.

Soil depth at each location was determined using a portable drill and bit, stainless-steel probe, and excavation with a manual post-holer (Figure 2). Rock samples representative of the underlying substrate were collected from the bottom of each excavated hole (Figure 3).

Results from this investigation show that for Parcel 17 (southern parcel) soil depth varied from 3-12 inches. For Parcel 19 (northern parcel) the soil depth is ≤ 15 inches. For both parcels, an organically rich and moist soil overlays a highly fractured volcanic substrate. Results are summarized in Table 1.

For Parcel 17, there is no evidence of significant fill material except at the northern margin (near sample location 4) which is plausibly the transition edge of fill used for development on Parcel 19.

For Parcel 19, soil depth and substrate characteristics suggest that ~ 1200 yd^3 of fill material was placed as part of the tennis court development and landscaping.

Figure 1. Locations for soil investigations (1-15)

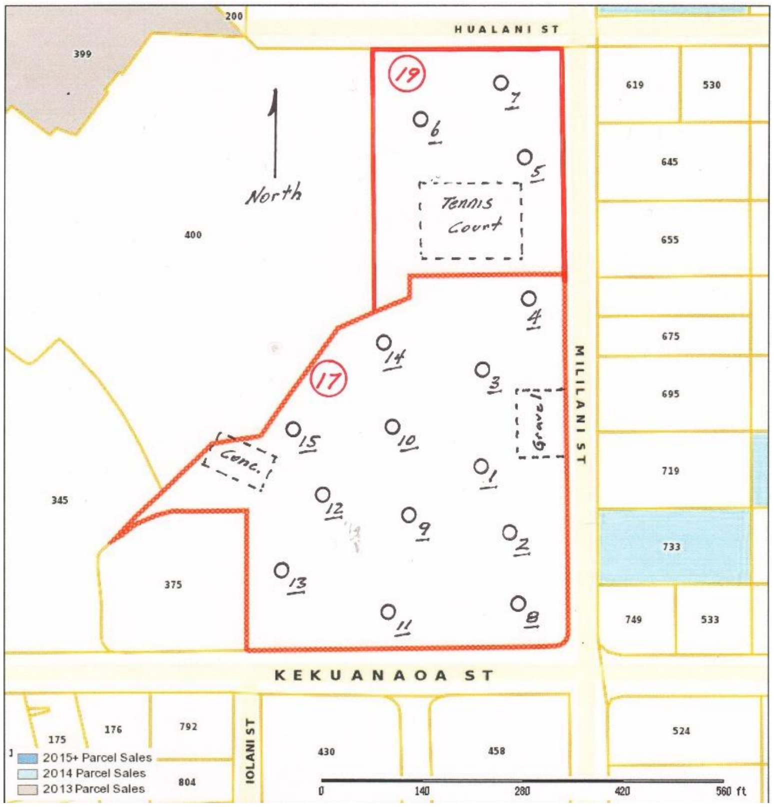


Figure 2. Field equipment for determining soil depth

Table 1. Summary of findings

Location	Parcel	Measured soil depth (in)	Soil characteristics	Substrate characteristics	Comments
1	17	7	Black to dark brown, moist, highly organic.	Fractured a'a or pahoehoe lava, size ~2-3 in.	Findings consistent with USDA-NRCS soils survey and previous investigations for Waiakea Villas and TMK (3) 2-2-30 17 & 19.
2	17	8	Black to dark brown, moist, highly organic.	Fractured a'a or pahoehoe lava, size ~2-3 in.	Findings consistent with USDA-NRCS soils survey and previous investigations for Waiakea Villas and TMK (3) 2-2-30 17 & 19.
3	17	9	Black to dark brown, moist, highly organic.	Fractured a'a or pahoehoe lava, size ~2-3 in.	Findings consistent with USDA-NRCS soils survey and previous investigations for Waiakea Villas and TMK (3) 2-2-30 17 & 19.
4	17	12	Black to dark brown, moist, highly organic, mixed with some quarried stone of ~ 1 in size. Presence of quarried material indicates fill.	Fractured a'a or pahoehoe lava, size ~2-3 in.	Findings consistent with USDA-NRCS soils survey and previous investigations for Waiakea Villas and TMK (3) 2-2-30 17 & 19.
5	19	15	Dark brown to brown, moist, mixed with some quarried stone of ~ 1 in size. Presence of quarried material indicates fill.	Fractured a'a or pahoehoe lava, size ~2-3 in.	Findings consistent with USDA-NRCS soils survey and previous investigations for Waiakea Villas and TMK (3) 2-2-30 17 & 19.
6	19	8	Dark brown to brown, moist, mixed with some quarried stone of ~ 1 in size. Presence of quarried material indicates fill.	Fractured a'a or pahoehoe lava, size ~2-3 in.	Findings consistent with USDA-NRCS soils survey and previous investigations for Waiakea Villas and TMK (3) 2-2-30 17 & 19.
7	19	11	Dark brown to brown, moist, mixed with some quarried stone of ~ 1 in size. Presence of quarried material indicates fill.	Fractured a'a or pahoehoe lava, size ~2-3 in.	Findings consistent with USDA-NRCS soils survey and previous investigations for Waiakea Villas and TMK (3) 2-2-30 17 & 19.
8	17	4	Black to dark brown, moist, highly organic.	Fractured a'a or pahoehoe lava, size ~2-3 in.	Findings consistent with USDA-NRCS soils survey and previous investigations for Waiakea Villas and TMK (3) 2-2-30 17 & 19.
9	17	7	Black to dark brown, moist, highly organic.	Fractured a'a or pahoehoe lava, size ~2-3 in.	Findings consistent with USDA-NRCS soils survey and previous investigations for Waiakea Villas and TMK (3) 2-2-30 17 & 19.

Table 1 (cont'd). Summary of findings

Location	Parcel	Measured soil depth (in)	Soil characteristics	Substrate characteristics	Comments
10	17	5	Black to dark brown, moist, highly organic.	Fractured a'a or pahoehoe lava, size ~2-3 in.	Findings consistent with USDA-NRCS soils survey and previous investigations for Waiakea Villas and TMK (3) 2-2-30 17 & 19.
11	17	4	Black to dark brown, moist, highly organic.	Fractured a'a or pahoehoe lava, size ~2-3 in.	Findings consistent with USDA-NRCS soils survey and previous investigations for Waiakea Villas and TMK (3) 2-2-30 17 & 19.
12	17	4	Black to dark brown, moist, highly organic.	Fractured a'a or pahoehoe lava, size ~2-3 in.	Findings consistent with USDA-NRCS soils survey and previous investigations for Waiakea Villas and TMK (3) 2-2-30 17 & 19.
13	17	3	Black to dark brown, moist, highly organic.	Slightly surface-fractured a'a or pahoehoe lava. No sample available due to monolithic characteristic of rock.	Findings consistent with USDA-NRCS soils survey and previous investigations for Waiakea Villas and TMK (3) 2-2-30 17 & 19.
14	17	8	Black to dark brown, moist, highly organic.	Fractured a'a or pahoehoe lava, size ~2-3 in.	Findings consistent with USDA-NRCS soils survey and previous investigations for Waiakea Villas and TMK (3) 2-2-30 17 & 19.
15	17	9	Black to dark brown, moist, highly organic.	Fractured a'a or pahoehoe lava, size ~2-3 in.	Findings consistent with USDA-NRCS soils survey and previous investigations for Waiakea Villas and TMK (3) 2-2-30 17 & 19.

These findings are highly consistent with authoritative geologic information for these parcels. The USDA-Natural Resources Conservation Service (NRCS) soil survey describes soils for TMK (3) 2-2-30 17 & 19 as Soil Type 640, Opihikao-Urban, organic material over pahoehoe lava flows, 2-10 inches to lithic bedrock.

Also consistent is that previous soils and substrate investigations for the adjacent Waiakea Villas development (Woodward-Clyde, 1989) described the soil of the Waiakea Villas area (including Parcels 17 & 19) as generally < 1 foot in thickness, overlying a hard basalt base.

Notably, observed soils and substrates at current construction sites along Kekuanaoa Street between Parcels 17 & 19 and Kanoelehua Ave are also consistent with these findings.

There is no evidence from this investigation, or from previous investigations, that there is significant fill material on Parcel 17 except at the northern margin adjacent to the tennis court development. Observations in the field show that soil depth is consistent across Parcel 17 (average depth ~ 6 ½ inches) and is underlain by natural lava rock (Figure 3). Evidence that the underlying rocks are natural in origin includes shape and texture. Quarried material used for fill does not have the irregular characteristics of the native lava. Quarried material is generally of a uniform blocky shape and size as a result of crushing and screening. Quarried and crushed material typically does not have the surface pitting of natural lava because the rock is split along shear planes that expose the consolidated and crystalline inner material. Quarried fill material typically contains a significant amount of fines as well, which were notably lacking in the substrate on Parcel 17. In conclusion, the irregular and pitted characteristics of the rocks and the lack of fines strongly support that the substrate encountered below the shallow soils of Parcel 17 is of natural volcanic origin.

There is substantial evidence for fill material on Parcel 19. The presence of quarried rock material and the soil thickness (see Table 1, locations 5, 6 & 7), and the presence of the tennis courts and landscaping, suggest that fill material was placed on Parcel 19. The amount of fill material appears minimal. Average soil depth on Parcel 19 is ~ 11 ½ inches, compared to parcel 17 (average depth ~ 6 ½ inches). If the parcels were originally about the same with regard to soil depth, then the difference is ~ 5 inches of fill on Parcel 19 today. Parcel 19 is ~ 1.8 acres. This amounts to ~ 1200 yd^3 of fill material. Fill material notwithstanding, the soil depth is still considered shallow (~ 15 inches or less) and the underlying bedrock is of natural volcanic origin similar to Parcel 17.

Figure 3. Typical rocks underlying shallow soil (locations 1-15);
samples 5, 6 & 7 are from Parcel 19

This investigation was conducted to resolve Hawaii DOH suggestions that vertical soil sampling for arsenic should be considered for any future Phase II ESA for Parcels 17 & 19. The data collected from this investigation does not support the DOH suggestion. Findings presented here strongly support that no further sampling for arsenic is required in order to complete regulatory due diligence for Parcels 17 & 19.

Field measurements and observations from this work will be used to establish that existing arsenic data is sufficient to prepare a conclusive Phase II ESA report for Parcels 17 & 19.

Thank you for this opportunity to work on this important project for the De Luz family. Please do not hesitate to contact us to discuss this matter further.

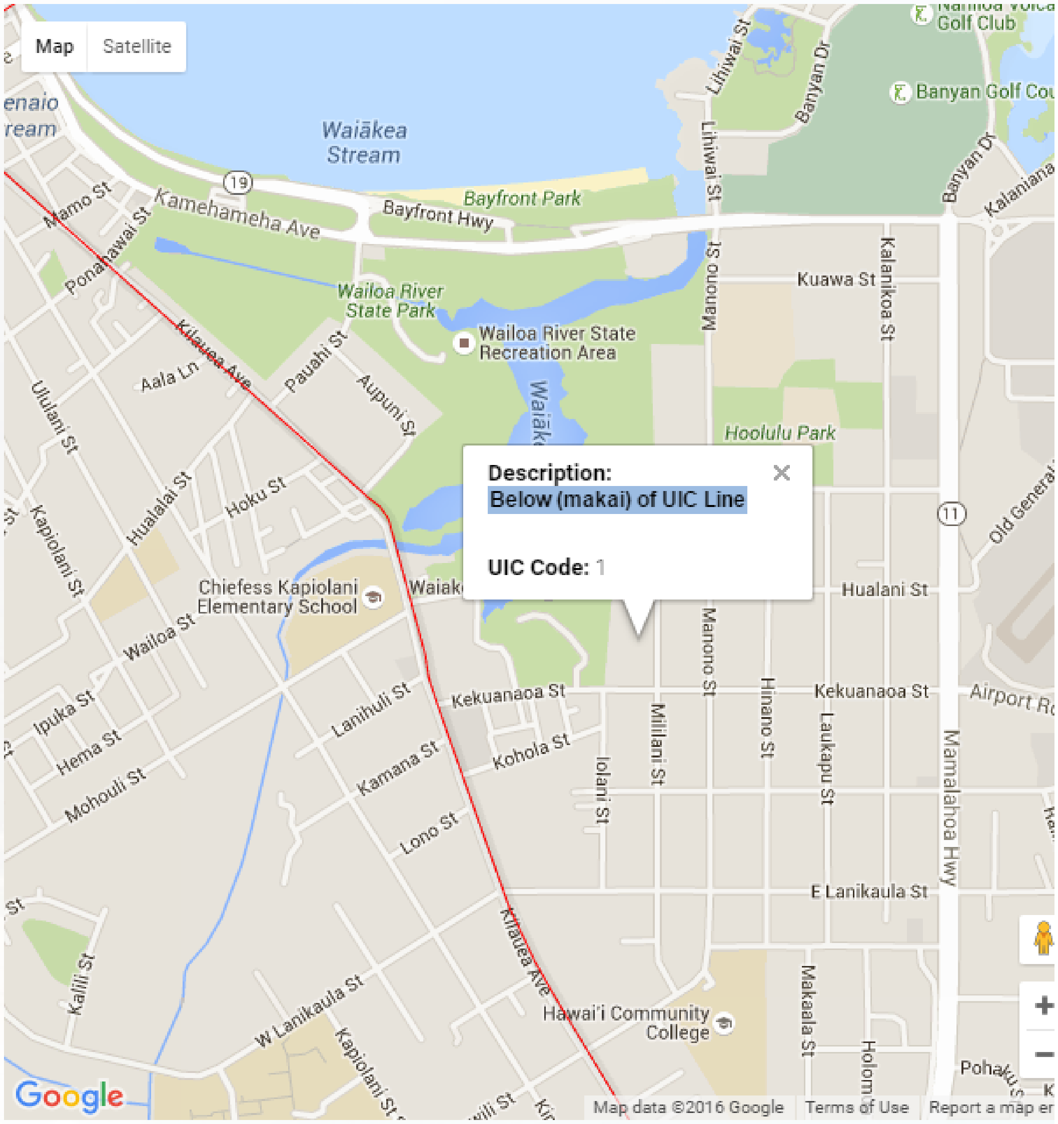
Sincerely,

Peter J. Peshut, PhD
Nimbus Environmental Services

APPENDIX E – Hawaii DOH UIC-line

Hawaii DOH UIC-line Map

Island of Hawaii



Contact Us

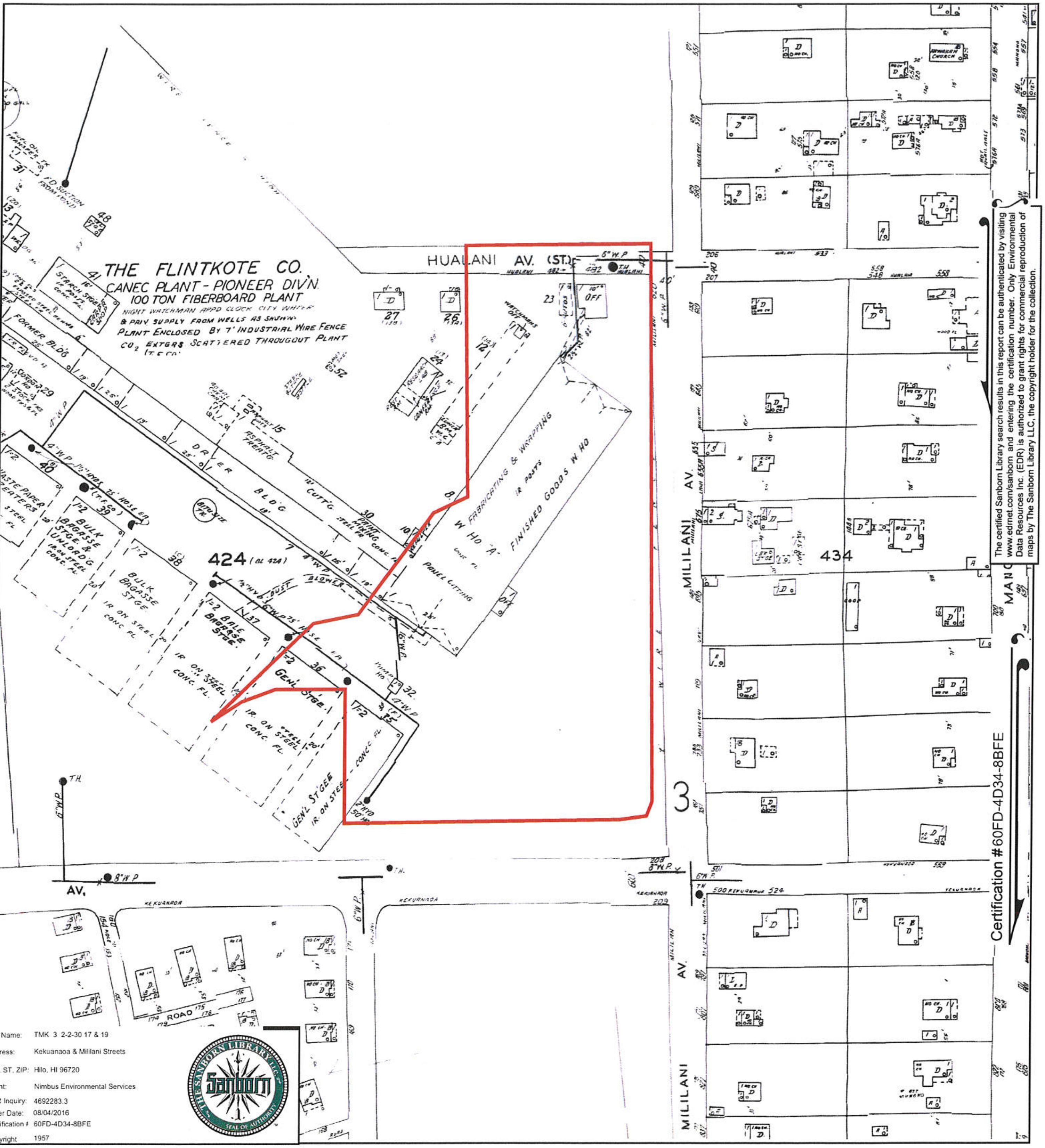
Phone: (808) 586-4258
Fax: (808) 586-4351
E-Mail: sdwb@doh.hawaii.gov

APPENDIX F – Selected Historical Records TMK (3) 2-2-30: 17&19

EDR

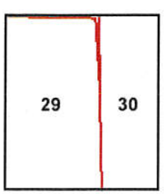
Certified Sanborn® Map

1957



Site Name: TMK 3 2-2-30 17 & 19
Address: Kekuanaoa & Mililani Streets
City, ST, ZIP: Hilo, HI 96720
Client: Nimbus Environmental Services
EDR Inquiry: 4692283.3
Order Date: 08/04/2016
Certification # 60FD-4D34-8BFE
Copyright 1957

This Certified Sanborn Map combines the following sheets.
Outlined areas indicate map sheets within the collection.



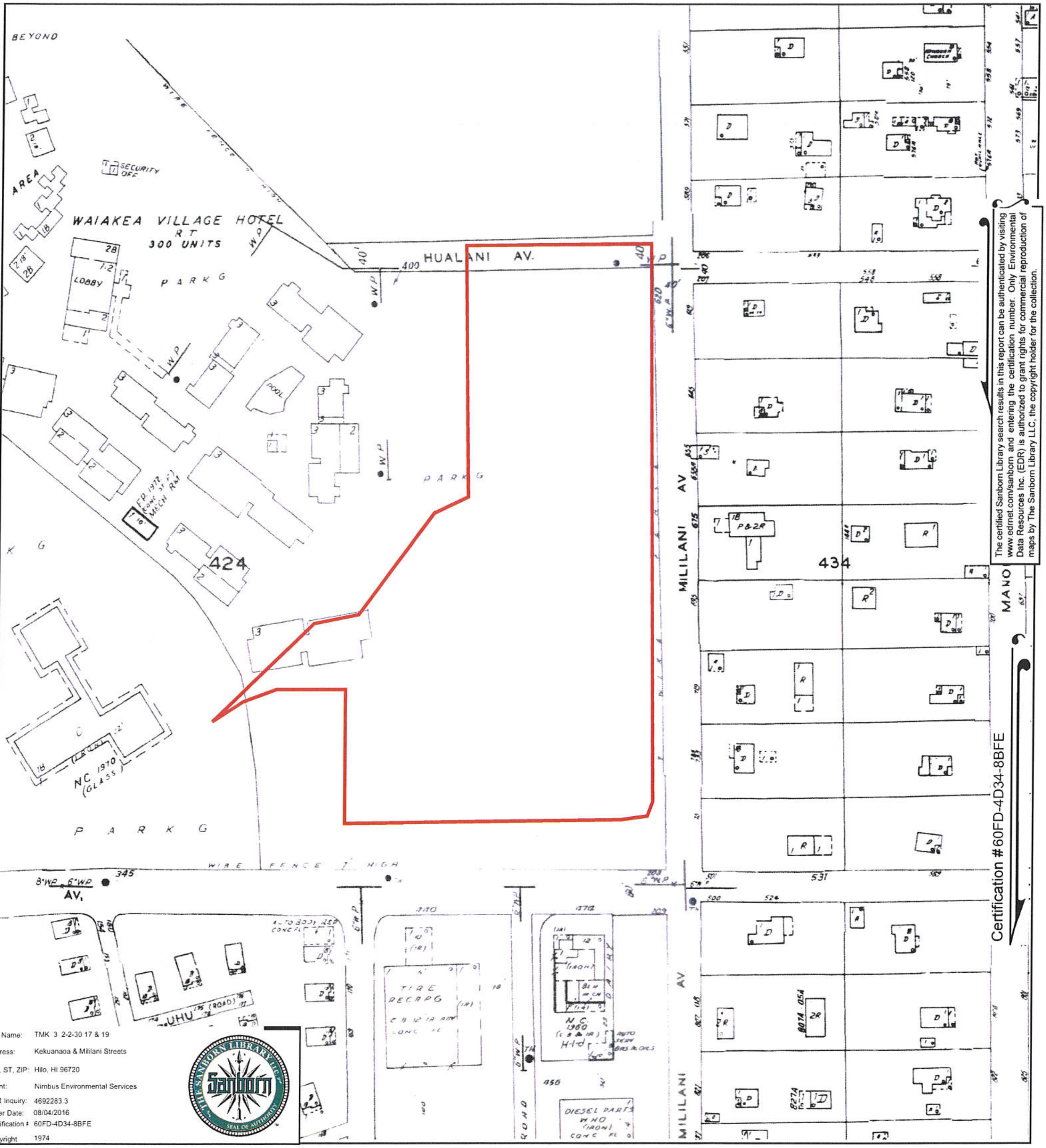
Volume 1, Sheet 29
Volume 1, Sheet 30

0 Feet 150 300 600

N

Certified Sanborn® Map

1974



Site Name:	TMK 3 2-2-30 17 & 19
Address:	Kekuanaoa & Mililani Streets
City, ST, ZIP:	Hilo, HI 96720
Client:	Nimbus Environmental Services
EDR Inquiry:	4692283.3
Order Date:	08/04/2016
Certification #	60FD-4D34-8BFE
Copyright	1974

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0 Feet 150 300 600

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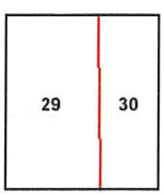
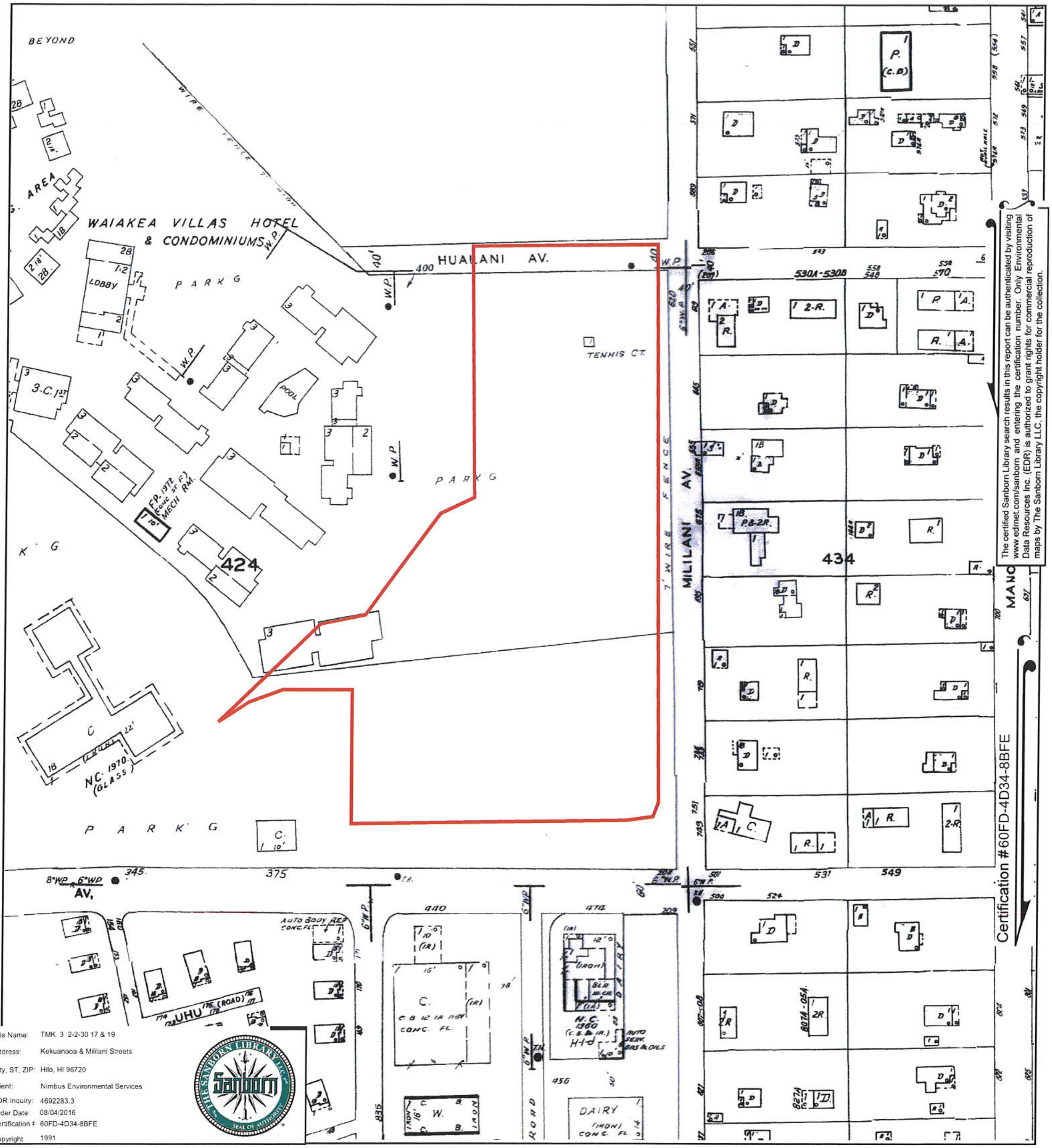


Volume 1, Sheet 30
Volume 1, Sheet 29

Certified Sanborn® Map

1991



Certification # 60FD-4D34-8BFE

Site Name: TMK 3 2-2-30 17 & 19
Address: Kekuanaoa & Mililani Streets
City, ST, ZIP: Hilo, HI 96720
Client: Nimbus Environmental Services
EDR Inquiry: 4692283.3
Order Date: 08/04/2016
Certification # 60FD-4D34-8BFE
Copyright 1991

This Certified Sanborn Map combines the following sheets.
Outlined areas indicate map sheets within the collection.

0 Feet 150 300 600

N

Volume 1, Sheet 30
Volume 1, Sheet 29

Historical Photograph: *Canec* Plant - 1932

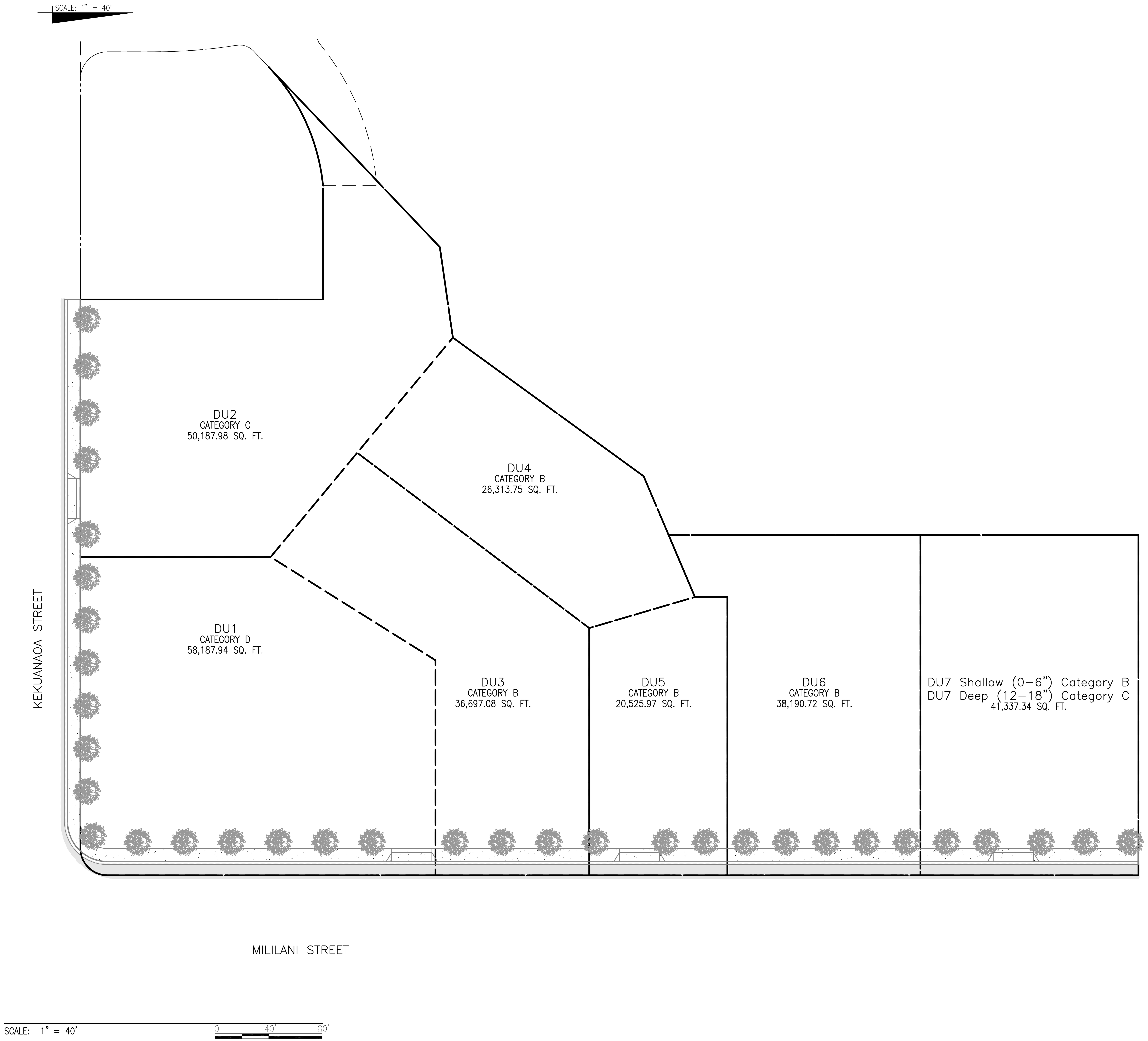
Canec plant two months after it opened with Waiākea Sugar Mill, Waiākea pond and vicinity, from 500 ft., 6/19/1932

Historical Photographs: Canec Plant – 1946, 1955

1946

1955

APPENDIX G – Site Plan



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SITE PLAN
SOIL CATEGORIES
COMMERCIAL PROPERTY
S. HILO, HAWAI'I, HAWAI'I
TMK: (3) 2-2-030: 017 AND 019

DRAWN BY:	DESIGNED BY:
CHECKED BY:	QC'D BY:

JOB NO.
17180–17–01

DWG. NO.

APPENDIX H – Personnel Qualifications

P.O. Box 72, Hilo, Hawaii 96721 **Peter Joseph Peshut** nes.pacific@gmail.com ph: +1 808 961 6029

Education

University of Wollongong (Australia) **- PhD, Environmental Science**
University of Guam Marine Laboratory (Guam) **- MSc**, **Biology**
Southern Illinois University (USA) **- BSc**, **Civil Engineering**

Publications

Morrison, R.J., **Peshut, P.J.**, West, R.J., Lasorsa, B.K. 2015. Mercury (Hg) speciation in coral reef systems of remote Oceania: Implications for the artisanal fisheries of Tutuila, Samoa Islands. Marine Pollution Bulletin 96, 41-56.

Morrison, R.J., **Peshut, P.J.**, Lasorsa, B.K. 2010. Elemental composition and mineralogical characteristics of coastal marine sediments of Tutuila, American Samoa. Marine Pollution Bulletin 60, 925-930.

Peshut, P.J., Morrison, R.J., Brooks, B.A. 2008. Arsenic speciation in marine fish and shellfish from American Samoa. Chemosphere 71(3), 484-492.

Costa, S.L., **Peshut, P.J.**, Goldstein, C.L., Glatzel, K.A., 2007. Sediment toxicity assessment for Pago Pago Harbor. In: Proceedings of the Fourth International Conference on Remediation of Contaminated Sediments, Savannah Georgia, USA.

Peshut, P.J. 2007. Environmental Assessment for *USS Chehalis*, Pago Pago Harbour, Phase III, Fuel Cargo Inspection. American Samoa EPA, 50 pp.

Peshut, P.J., Furey, J., 2006. Our public infrastructure. In: Furey, J. (ed.), Island Ecology and Resource Management. Angil Design, Saipan, pp. 555-573.

Peshut, P.J., 2006. Managing our solid wastes. In: Furey, J. (ed.), Island Ecology and Resource Management. Angil Design, Saipan, pp. 663-672.

Peshut, P.J., 2006. Controlling air pollution and noise. In: Furey, J. (ed.), Island Ecology and Resource Management. Angil Design, Saipan, pp. 673-682.

Peshut, P.J., 2006. Water pollution: sources, monitoring, and prevention. In: Furey, J. (ed.), Island Ecology and Resource Management. Angil Design, Saipan, pp. 683-701.

Peshut, P.J., Furey, J., Francis, K., 2006. Community aesthetics; building design, landscape management, and our community parks. In: Furey, J. (ed.), Island Ecology and Resource Management. Angil Design, Saipan, pp. 703-730.

Peshut, P.J., Brooks, B.A. 2005. Tier 2 Fish Toxicity Study; Chemical Contaminants in Fish and Shellfish and Recommended consumption Limits for Territory of American Samoa. American Samoa EPA, 118 pp.

Peshut, P.J. 2003. Monitoring demonstrates management success to improve water quality in Pago Pago Harbor, American Samoa. In: Wilkinson, C., Green, A., Almany, J., Dionne, S. Monitoring coral reef marine protected areas, a practical guide on how monitoring can support effective management of MPAs. Australian Institute of Marine Science and IUCN Global Marine Program, pp. 36-37.

Experience

2017 - present; US Army Garrison - Pohakuloa, Hawaii Island (USA).
Director, Public Works. Manages all aspects of facilities engineering for maintenance and repair and coordinates new construction for 133,000 acre military training installation. Supervises staff of 15 and prepares/manages annual budget of ~$10 million USD. Provides direction for all facilities engineering, municipal services, and base operations related to Sustainment/Restoration/Modernization (SRM) funding. Reviews proposals from Garrison Directorates for improved or enhanced military training capabilities. Makes recommendations for infrastructure to provide enhanced training capabilities, and coordinates/manages construction of approved initiatives. Reviews/approves service contracts and supervises Contracting Officer Representatives. Develops training initiatives for staff. Area of Responsibility (AOR) includes 200+ structures, 160 miles of range roads, wastewater collection and treatment system, power distribution, and potable water system.

Provides technical assistance to Environmental Division for preparation of US National Environmental Policy Act (NEPA) documents including Environmental Impact Statements, Environmental Assessments, and Records of Environmental Consideration, for federally protected flora and fauna and native habitat of high conservation value.

2016; US Geological Survey – Pacific Islands Climate Science Center, Hawaii Island (USA).
Science Coordinator. Managed all aspects of project development and delivery for the Pacific Islands Climate Science Center (PI CSC). The PI CSC identifies and funds scientific research projects based on expressed needs of stake-holders. Stake-holders are comprised of resource managers (government, utilities, NGOs, private sector) among the six US Affiliated Pacific Islands (USAPI) jurisdictions (Palau, FSM, RMI, CNMI, Guam, American Samoa). PI CSC-sponsored research is focused on building resilience and adaptation mechanisms through coastal hazards evaluations and engineering applications for human populations and ecosystems, in response to identified or anticipated impacts due to climate change projections (through year 2100).

The Science Coordinator is a key technical and managerial function for the PI CSC.

The basis of the PI CSC research portfolio is the 5-year "Science Agenda" (current 2014-2018). The Science Agenda is prepared from stake-holder input and codifies the 5-year research emphasis for the PI CSC. The Science Coordinator seeks proposals from the scientific/research community to address expressed stake-holder needs, then evaluates proposals in the Science Agenda framework. The Science Coordinator provides technical review to Principal Investigators (PIs) and makes a final recommendation to the Director whether a proposal will receive funding.

Funded proposals are assigned "Project " status, and all aspects of budget and deliverables are then managed by the Science Coordinator. Regular project progress and budget meetings are scheduled with PIs to track and ensure project completion. Typical project duration is 24-36 months; typical project funding is $50,000 - $300,000. Current PI CSC research portfolio comprises 24 projects, totaling $2.5 million, extending to late calendar 2019. Projects range widely in scientific scope and focus. Research focus includes infrastructure impacts, hydrology, habitat, vegetation communities, sea level rise, groundwater availability, and climate projections.

Met regularly with senior USAPI State and Federal officials to help guide planning and other strategic efforts for climate change adaptation and resiliency.

2009 - 2016; US Army Garrison - Pohakuloa, Hawaii Island (USA).
Manager, Natural Resources Office and Contracting Officer Representative supervising staff of 50 and budget of $4+ million USD. Biologist/Engineer for natural resources compliance program. Provided daily oversight and technical guidance to ensure military training activities are consistent with the intents and purposes of Biological Opinions issued by US Fish and Wildlife Service. Planned and implemented scientific investigations to characterize potential impact of military training activities on protected species and habitat. Conducted inter-agency consultations under Section 7 of the US Endangered Species Act and Migratory Bird Treaty Act. Provided technical assistance to all Pohakuloa Directorates for matters of environmental compliance, environmental engineering, and environmental chemistry.

Provided technical assistance to Environmental Division and co-authored US National Environmental Policy Act (NEPA) documents including Environmental Impact Statements, Environmental Assessments, and Records of Environmental Consideration, for federally protected flora and fauna and native habitat of high conservation value.

2008 - present; Nimbus Environmental Services, Hawaii Island (USA).
Environmental scientist/engineer for Hawaii-based, sole proprietorship, Woman's Business Enterprise, registered as a Small Business under System Award Management (SAM) with the United States federal government. NES offers a diverse range of technical services to Pacific Islands States, Territories, and Countries to assist governments, utilities, industry, and private sectors, with environmental management and protection of public health. Services include: compliance assistance; engineering reviews; water quality assessments and monitoring; laboratory performance audits and certification; review, guidance, and authorship for Environmental Impact Statements and Environmental Assessments under local jurisdiction regulatory framework; site remediation design and management; and water/wastewater system performance audits. Consultancy portfolio (completed and current) ~$1 million USD.

2001-2008; American Samoa Environmental Protection Agency, Pago Pago, American Samoa (South Pacific).
Program Manager for Technical Services (Deputy Director *de facto* 2001-2003, 2005-2008, Acting Director 2004).
Biologist/Engineer for government regulatory agency managing staff of 35 and budget of $2.5 million USD. Provided managerial and technical assistance to Director and to all Program Managers for compliance, environmental, and conservation programs development and implementation.

Regulatory programs focused on water quality protection and improvement (ground water and surface waters), solid waste management, pesticides management, persistent toxic substances, air quality, and land-use regulation. Environmental/Conservation Programs focused on land development policies, habitat protection and re-habilitation, invasive species, animal husbandry practices, and application of best-management-practices for development projects. An inter-agency, government-wide approach was essential for successful implementation of these initiatives.

Reviewed/approved Environmental Impact Statements and Environmental Assessments to ensure compliance with local jurisdiction statutes and regulations.

Developed and implemented Education Assistance Program to encourage and promote tertiary education among staff. This program provided funding for attendance at the American Samoa Community College, on-line distance education, and off-island university attendance. Provided staff with regular in-house classroom sessions in fundamentals of mathematics and general science.

Presented technical and policy seminars and workshops to village councils, other government agencies, and the general public, upon request.

1999 - 2000; Winzler & Kelly, Consulting Engineers, Guam (Philippine Sea).
Environmental and civil design engineer, and technical writer. Prepared written technical environmental planning documents to ensure that proposed projects met Federal and Territorial environmental laws and regulations, NEPA requirements, and local integrated natural resource management plans.

Used working knowledge of botany, plant ecology, and hydrology to prepare complex ecological and environmental assessments as Principal technical writer for Guam Wetlands Management Plan.

Designed and prepared technical engineering drawings, and prepared technical written specifications for materials and methods of construction, for 4000-acre artillery training range for Army Tank Corps in South Korea.

Designed and prepared technical engineering drawings, and prepared technical written specifications for materials and methods of construction, for 900-gpm Guam public golf course irrigation system.

1998; University of Guam Marine Laboratory, Guam (Philippine Sea).
Engineering design review and construction inspection services for new flow-through seawater system. Open-air, *lanai* system provides tankage for holding marine specimens for research and study. This work required effective communication of technical material to Filipino and Korean workers with limited English skills.

1997; Coastal Resources Management Office, Saipan, Northern Mariana Islands (Philippine Sea).
Technical writer for *Island Ecology and Resource Management*. Principal technical writer for five chapters on Pacific Islands resource management. Advised on, and partially produced, several chapters on island ecology. This textbook was produced with grant funding through CRMO, and is used in the Marianas High School and the Northern Marianas College for the science curriculum (see publications).

1995 – 1996; Division of Environmental Quality (BECQ), Saipan, Northern Mariana Islands (Philippine Sea).
Environmental engineer for government regulatory agency. Evaluated proposed and on-going development projects for compliance with Federal and Territorial environmental laws and regulations, NEPA requirements, and local integrated natural resources management plans. Used personal knowledge of ecological and engineering principles, together with available biological and ecological data for local ecosystems, to predict impacts of proposed construction projects.

Prepared technical permit conditions for approved construction projects.

Coordinated environmental program initiatives with Federal agencies, local government agencies, and private sector.

Planned and conducted ecological background surveys and site inspections to determine probable causes of environmental degradation and impacts on human health.

Selected and applied environmental sampling techniques, evaluated and selected sampling equipment, and selected and applied statistical design techniques, in accordance with appropriate sampling and analyses protocols for aquatic and terrestrial environmental investigations.

As senior technical staff of CNMI Government; participated in environmental policy development; provided technical assistance for infrastructure planning for disaster mitigation projects; attended public hearings representing DEQ and USEPA policies and programs for water, wastewater, solid waste and other environmental initiatives.

1993 – 1995; Nantucket Marine Laboratory, Nantucket Island, Massachusetts (USA).
Part-time engineering consultant. Prepared hydraulic design and re-built tankage, piping and pumping systems for oyster and scallop hatchery. The NML was a grant-funded seed project mandated to make transition to full-scale commercial operation as part of re-vitalization efforts for the Nantucket shellfish fishery. First commercial harvest achieved in 1996.

1988 – 1995; Universal Engineering Corporation, Boston, Massachusetts (USA).
Environmental design engineer for large- and small-scale water and wastewater treatment facilities. Provided technical services for all aspects of engineering design, construction management, and project contract administration for $150 million USD in water and wastewater infrastructure development.

Prepared complex technical wastewater and water facilities planning documents to assess project compliance with Federal and State environmental regulations, and to assess construction project impacts on local communities, environment, and natural resources.

Coordinated project implementation with Federal agencies, State agencies, and private contractors. Prepared technical written specifications for projects materials and methods for construction.

Designed approximately 15 medium-scale civil works projects for drainage, grading, and utilities. Specialized in fluids flow designs and flow rate control designs.

1987; Ross Engineering Company, Norwell, Massachusetts (USA).
Design engineer for subdivision development projects, and manager of field survey crews.

Other Skills and Competencies

- Competent and highly experienced with Uni Stat® Statistical Programs for scientific data analyses.
- Competent and highly experienced with Grapher 9® Graphing and Analysis Programs for scientific data preparation and analyses.
- Competent and highly experienced with Microsoft® Word, Excel, and PowerPoint, Corel® Word Perfect and Quattro Pro, and Adobe Pro XI®.

Certifications

- Dive Master, #D0011995, National Association of Underwater Instructors.
- Contracting Officer's Representative, Regional Contracting Office, US Army Pacific Headquarters, Ft Shafter, Hawaii.
- Trusted Agent, Resource Management Office, US Army Garrison-Hawaii, Schofield Barracks, Hawaii.

P.O. Box 72, Hilo, Hawaii 96721

Edna Lucille Buchan

nes.pacific@gmail.com ph: +1 808 961 6029

Education

- University of Wollongong (Australia) **- MSc, Environmental Science**
- University of British Columbia (Canada) **- BSc, Medical Laboratory Science**
- Southern Alberta Institute of Technology (Canada) **- Honors Dipl-Medical Laboratory Technology**

Certifications

- Laboratory Certification Officer (Microbiology and Chemistry) - US EPA
- Registered Technologist, No. 06456 - Canadian Society of Laboratory Technologists
- 40-Hour Hazardous Waste Operations and Emergency Response - US OSHA
- Rescue Diver, No. 9009445322 - Professional Association of Diving Instructors (PADI)

Distinctions & Awards

- Non-Point Source Program Success Story - US EPA 2006
- Environmental Award (Watershed Protection) - US EPA 2008

Experience

2009 – present; Center for Environmental Management of Military Lands, Hawaii Island (USA)

Administrative Program Manager for operations support (environmental compliance, safety, and administrative support) assigned to Pohakuloa Training Area, Hawaii Island. CEMML provides technical assistance to US Army Garrison-Pohakuloa, under contract, for natural resources management. Operations support is integral with all technical programs functions (Botanical Program, Wildlife Program, Invasive Plants Program, and Ecological Data Program).

2008 – present; Nimbus Environmental Services, Hawaii Island (USA)

Owner and environmental scientist for Hawaii-based, sole proprietorship, Woman's Business Enterprise, registered as a Small Business under System Award Management (SAM) with the United States federal government. NES offers a diverse range of technical services to Pacific Islands States, Territories and Countries, to assist governments, utilities, industry, and private sectors with environmental management and protection of public health. Services include compliance assistance, engineering reviews, water quality assessments and monitoring, laboratory performance audits and certification, environmental assessments, site remediation design and management, and water/wastewater system performance audits.

2001 – 2008; American Samoa Environmental Protection Agency, Pago Pago, American Samoa (South Pacific)

Water Program Manager and senior technical officer for government environmental regulatory agency, managing staff of 15 and budget of $1 million (USD). Responsible for Safe Drinking Water, Non-point Source Pollution Control, Water Quality Laboratory, and Public Education program branches. Principal management and technical responsibilities included:

- Research and monitoring activities for marine and freshwater ecosystems;
- Monitoring activities for drinking water supplies;
- US Freely Associated States Laboratory Certification Program;
- Preparation and review of environmental planning documents;
- Public water system compliance and enforcement under US EPA Safe Drinking Water regulations;
- Sanitary surveys of public water systems;
- Watershed and wetland protection programs;
- Laboratory analytical services for microbiological and chemical contaminants;
- Preparation of revisions for Territorial water quality regulations;
- Community education and outreach activities;
- Extensive employee professional development through in-service training initiatives.

1997 – 2000; Guam Environmental Protection Agency, Guam (Philippine Sea)

Environmental Monitoring and Analytical Services (EMAS) Administrator, and senior technical officer, for government environmental regulatory agency, managing staff of 10 and budget of $1 million (USD), responsible for Water Quality Laboratory, Environmental Monitoring, and Compliance and Enforcement program branches. Principal management and technical responsibilities included:

- Research and monitoring activities for marine and freshwater ecosystems;
- Monitoring activities for drinking water supplies;
- Preparation and review of environmental planning documents;
- Territory-wide Laboratory Certification Program;
- Watershed and wetland protection programs;
- Compliance and enforcement initiatives for development projects;
- Laboratory analytical services for microbiological and chemical contaminants;
- Preparation of revisions for Territorial water quality regulations.

1992 – 1996; Division of Environmental Quality (BECQ), Saipan, Northern Mariana Islands (Philippine Sea)

Laboratory Manager for water quality laboratory and drinking water and marine water monitoring programs, managing staff of 6 and budget of $250,000 (USD). Designed and supervised construction of new laboratory facility. Provided start-up services for environmental laboratory including development of Standard Operating Procedures, QA/QC manuals and record-keeping system to meet US EPA certification standards. Developed and coordinated research and monitoring of drinking water and marine and freshwater ecosystems. Revised Water Quality Standards for marine and fresh waters. Reviewed environmental planning documents. Developed and implemented extensive in-service employee training programs.

1989 – 1991; Environmental Quality Protection Board, Republic of Palau (Caroline Sea)

Laboratory Manager for water quality laboratory and drinking water and marine water monitoring programs, managing staff of 5 and budget of $50,000 (USD). Provided start-up services for water quality laboratory, including development of Standard Operating Procedures, QA/QC manuals, and record-keeping system to meet US EPA laboratory certification standards. Developed and coordinated research and monitoring for drinking water, and marine and freshwater ecosystems. Revised Water Quality Standards for marine and fresh waters. Reviewed environmental planning documents for compliance with local and federal statutes and regulations. Developed and implemented extensive in-service employee training programs.

1986 – 1987; Chuuk State Hospital, Federated States of Micronesia (Caroline Sea)

Manager of hospital medical laboratory. Supervised all functions and activities of chemistry, microbiology, hematology, and blood bank sections. Doubled the types of analyses available. Implemented QA/QC program. Developed and implemented extensive in-service employee training programs.

1985 – 1986; LBJ Tropical Medical Center, Pago Pago, American Samoa (South Pacific)

Supervisor of blood bank and chemistry sections. Developed and implemented QA/QC program. Revised laboratory Standard Operating Procedures manuals. Established first stocked blood bank in American Samoa.

1975 – 1984; Various medical laboratories, British Columbia (Canada)

Analytical technologist for medical and hospital laboratories. Performed laboratory analyses in chemistry, microbiology, and hematology.

Other Skills and Competency

- Competent and highly experienced with Uni Stat® Statistical Programs for scientific data analyses.
- Competent and highly experienced with Grapher 9® Graphing and Analysis Programs for scientific data preparation and analyses.
- Competent and highly experienced with Microsoft® Word, Excel, and PowerPoint, and Corel® Word Perfect and Quattro Pro.